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RAILWAY
MECHANICAL ENGINEER

Diesels in Road Service*

P. H. Hatch

By P. H. Hatch[†]

Experience on the New Haven has resulted in development of ratings and maintenance schedules

The New Haven Diesel-electric road locomotives initially operated on a double-track main-line section of railroad 157 miles long, running generally along the seacoast, and this is still the major operating territory for these locomotives. Ruling grade eastbound is 0.40 per cent and westbound is 0.71 per cent, both occurring between Providence, R. I., and Boston, Mass. There are several lesser grades in both directions, with a particularly difficult spot at New London, Conn., which is aggravated by severe curvature and speed restrictions imposed by city limits and two drawbridges. There are a total of 58 speed restrictions between New Haven and Boston; these, together with relatively frequent stops, fast schedules, and a high degree of traffic density, impose an exacting duty on motive power.

The Diesel-electric locomotives operated in this territory consist of a total of twenty Alco-GE 2,000-hp. "A" units coupled back to back in pairs forming ten 4,000-hp. double-end locomotives. Each unit can, if desired, be operated as a single 2,000-hp. single-end locomotive, but traffic demands have been such that very little of this type of operation has taken place.

Each 4,000-hp. locomotive, therefore, consists of two cabs, is 149 ft. 1 in. in length between coupler faces, weighs in working order 355 tons, of which 236.5 tons are on drivers, has 118,250 lb. starting tractive force at 25 per cent adhesion and 50,400 lb. continuous tractive force at 25.2 m. p. h., and has a maximum speed limited by traction motor gearing of 80 m. p. h.

Motive power equipment consists of four Alco 1,000-hp., four-cycle, six-cylinder, 12½-in. by 13-in., 740-r. p. m., supercharged Diesel engines each direct connected to a General Electric traction generator, and auxiliary generator and a Westinghouse Air Brake, two-cylinder, two-stage air compressor. A traction-motor blower, radiator fan drive, and special type of exciter are belt-driven. There are four six-wheel trucks, two under each cab, each having two General Electric traction motors driving the leading and trailing pairs of wheels, the middle pair being idlers; each Diesel engine-generator set supplies power to the traction motors on the truck beneath it.

The 4,000-hp. locomotive has two automatically controlled, 200-lb. pressure, Vapor steam generators, one in each cab, giving a total steam generating capacity of 4,500 lb. per hr. Total fuel-tank capacity for the entire locomotive is 2,400 gal., water tank capacity 2,000 gal., and sand box capacity 3,200 lb. Westinghouse schedule 8-EL air brake equipment, Exide Ironclad 32-cell KT-35A storage batteries and General Railway Signal coded cab signal equipment complete the major items of locomotive apparatus.

Mention was made of 80 m. p. h. traction-motor gearing. The gearing installed in this type of locomotive on other roads permits a top speed of 120 m. p. h. On a railroad with maximum speed restricted to 70 m. p. h., 120 m. p. h. gearing would be of no benefit in passenger service, aside from a slightly higher degree of engine horsepower utilization, and in freight service would impose definite limitations on tonnages which could be handled. The lowest practicable gearing which could be installed was for 80 m. p. h. top speed and this was ideal for passenger service since it provided a margin of 10 m. p. h. over the maximum allowable speed and in Shore Line freight service permitted the Diesel-electric locomotives to be used interchangeably with the heaviest steam freight locomotives.

Since the freight movement between New Haven and Boston was of the fleet variety and took place principally at night, both for early morning delivery in Providence and Boston, and because of the very heavy passenger movement during the day time, daily mileage for freight locomotives was necessarily low. In order to utilize the new locomotives and the investment therein to the fullest extent possible, they have been operated generally

* Abstract of a paper presented before the New England Railroad Club, Boston, Mass., January 11, 1944.
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in freight service during the night and in passenger service during the day. This virtually doubled the mileage to be operated per locomotive per day and constituted the first large scale operation of Diesel-electric locomotives in combination freight and passenger service.

Locomotive Rating

As a result of careful speed-time calculations, car and tonnage ratings for passenger and freight trains between New Haven and Boston were set prior to the locomotives going into service. Maximum rating in passenger service with six stops on the then existing schedule between New Haven and Boston, eastbound and westbound, was 16 cars, 1,270 trailing tons. Due to the nature of the profile, a single rating could not be given for freight service and, therefore, separate ratings were set:

Eastbound	
New Haven to Providence	112 cars, 4,500 trailing tons
Providence to Boston	100 cars, 4,500 trailing tons
Westbound	
Boston to Providence	93 cars, 2,800 trailing tons
Providence to New Haven	120 cars, 3,600 trailing tons

From the standpoint of train operation and maintenance results, these ratings have proved entirely satisfactory and are still in effect.

As a check on the eastbound ratings in freight service, a run was made shortly after the first 4,000-hp. locomotive was placed in operation with trailing tonnages almost exactly according to the 4,500- and 4,000-ton figures just mentioned. Aside from the fact that the run was successfully made and confirmed the ratings which had been set, it is of special interest to note that 89 per cent of the actual running time of 3 hr. and 58 min. was made with power on and 70 per cent was made with the master controller in the highest notch. And after handling a freight train of this nature, the locomotive was ready for immediate assignment to a fast passenger train.

For the Shore Line of the New Haven the outstanding feature of the locomotives, apart from the obvious advantages of Diesel-electric operation, is their interchangeable use in freight and passenger service. This has more than fulfilled expectations and has provided the highest possible degree of flexibility in locomotive assignment. It has paid dividends over and over in handling wartime freight and passenger traffic superimposed on regular service. As for the locomotives themselves, they have been equally satisfactory as freight locomotives and as passenger locomotives.

This idea of an interchangeable locomotive is not new for there have been cases of both steam and electric locomotives being operated in this way. With Diesel-electric locomotives joining the procession, interesting possibilities are opened up for future motive power. It may very well be that an interchangeable locomotive will be a requirement for post-war operation.

It would be possible to secure a locomotive of a certain type that would help out during the war years—at a price—but which would not be satisfactory for the long pull during the years to come after the war because of high maintenance or unreliable operation. It is desirable, therefore, that the Diesel-electric road locomotives on the New Haven be surveyed from that angle.

As will be shown in the following, results of such a survey are highly encouraging.

Regular maintenance schedules for Diesel-electric road locomotives were originally set up on a daily, weekly, monthly and 125,000-mile basis. This has now been changed to a daily, semi-monthly and monthly basis, with a few special items handled at 125,000-mile intervals. All of this is taken care of at the Dover street enginehouse, Boston, Mass.

At 250,000-mile intervals, the locomotive units are sent to the Van Nest shops in New York for Class 3 repairs, the purpose of which is to do all of the Diesel engine, electrical and mechanical repair work necessary including final load testing and adjustment of power plants, to put the locomotives in shape for the next 250,000 miles of operation with no further attention beyond running repairs and the routine work described.

Class 3 repairs are not considered as a general overhaul but rather as an accumulation of heavier running repairs that should be taken care of after about 250,000 miles of operation and which can most conveniently be handled where the necessary special equipment and facilities are available. Locomotive overhauls, as such, are not at present contemplated since Diesel-electric locomotives lend themselves readily to overhaul of individual parts which, when the time comes, can be distributed among the Class 3 repairs.

In brief, Class 3 repairs for the Diesel engines include reconditioning of cylinder heads, testing of connecting rods, installation of new piston rings, and if necessary, regrooving of pistons, honing of cylinder liners, inspection of all main and crank-pin bearings, testing of crankshaft, reconditioning of water pump, governor, throttle operator, turbo-supercharger and fuel injection equipment, cleaning and testing of water and oil radiator sections, reconditioning of radiator fan drive, replacement or recalibration of engine pressure and temperature switches and gauges, reconditioning of air compressor valves and unloaders and installation of new piston rings, and additional work of similar nature so that the entire Diesel engine and all its auxiliaries are given attention.

Similarly, activities in connection with the electrical equipment involve dismantling and cleaning of generators and exciters, inspection and repacking of brushholders and, if necessary, redressing of commutators, removal and reconditioning of all contactors, relays and reversers, recalibration of meters, cleaning of wires and cables, reconditioning of fuel and water transfer pumps, and general inspection of all other electrical equipment on the unit. The locomotive power plant is finally given a complete load test on a high-capacity water rheostat.

Mechanical and general work include detailed inspection and necessary repairs to trucks and all their component parts, checking over of underframe, inspection of draft gears, couplers, sanding equipment and water, oil and steam lines, cleaning and flushing of fuel and water tanks, necessary painting, air brake attention, inspection of cab signal equipment, complete inspection with necessary renewals and repairs of steam generator and all its auxiliaries, and general inspection of all other locomotive parts and accessories.

It will be noticed in the foregoing that traction motors are conspicuous by their absence; also, that for 250,000 miles of operation truck work is general rather than specific. The reason for this is that due to routine truck changes required for wheel turning, trucks as a whole are given necessary current attention so that only the long term work is necessary at Class 3 repairs. Two complete spare trucks with traction motors, incidentally, are used for this truck changing program. Since traction motors are kept continually in the same trucks, being changed out only in case of failure or high mileage, traction motor total mileage usually bears no relation to the total mileage of the unit the motors are in. Hence, traction motors are changed out for Class 3 repairs and sent to Van Nest independently of the locomotive units.

Class 3 attention given to traction motors includes dismantling, thorough cleaning, inspection and repacking of bearings, reconditioning of brushholders and usually a light grinding of the commutator. Any loose banding is renewed.

The present Class 3 repairs now being given the locomotives are their first and include a number of minor changes found necessary during the 250,000 miles or more of service. The changes are of a permanent nature and are, therefore, non-repeating.

Unit Replacement

Mention of overhaul brings up the subject of spare parts for Diesel-electric locomotives. How much investment is justified on the part of a railroad? How far should the manufacturers go in protecting their customers? Should the unit replacement program be followed or should each unit of equipment be removed and repaired for replacement in the locomotive in which it was originally installed?

It seems quite apparent that an adequate investment in spare parts by the railroad, to protect the larger investment in the locomotives themselves, is justified. Spare parts should be looked on as insurance and provided in proportion to the value of the locomotive as a modern, active unit of motive power. Those parts should be bought which experience has shown are most likely to fail, or in case of failure would be the hardest to repair quickly.

It is self-evident that most, but not all, of the casualties in service can thus be foreseen and protected against. But other casualties, usually of a major nature, can occur, though infrequently, and are very serious if they do, usually tying up the locomotive for a long time making repairs. It would seem that parts to protect against this type of casualty should be stocked by the manufacturers since the risk of occurrence on any single railroad is small but spread over a number of railroads may be appreciable.

Answering the third question, the Diesel-electric locomotive is essentially an assembly of small, independent parts for which a unit replacement program is particularly suited. It makes possible production methods in the shop and materially reduces actual time the locomotive is out of service, so that unit replacement of parts is virtually a "must" for Diesel-electric operation on a large scale.

Much the same reasoning applies to tools and to servicing and maintenance facilities. While it is possible to operate Diesel-electric locomotives with a minimum of such equipment, particularly at the start, it seems in this case also good insurance to give both locomotives and personnel every advantage possible in the way of adequate and efficient means to do the work that has to be done.

As mentioned previously, a period of 250,000 miles was set for Class 3 repairs to the road locomotives; a range of 240,000 to 260,000 miles was set for the traction motors. Due to the requirements of service, these mileages in some cases have been exceeded. the highest locomotive mileage being in excess of 287,000 miles and the highest traction motor mileage being in excess of 300,000 miles. While conditions noted on the first Class 3 repairs cannot be taken as criteria for succeeding Class 3's, nevertheless there is promise of being able ultimately to extend the mileages beyond the figures originally set.

On release from Van Nest after such repairs, the locomotive units usually proceed light to New Haven where they are coupled to a train in place of a unit bound for the shop and thus may enter main line revenue service within two or three hours after leaving the shop. This is made possible primarily by the thorough breaking in and testing of power plants on the water rheostat as part of the Class 3 procedure.

Apparatus History

The dismantling and inspection incident to Class 3 repairs have disclosed nothing of serious nature requiring design changes. This is particularly pleasing in view of the intensive operation of the locomotives.

It is also pleasing to report that cures have been developed and applied to most of the troubles originally experienced. Engine mounting difficulties on the first ten locomotives have been corrected by a new type of sub-base with the additional advantage of interchangeability of mounting with that of the second ten locomotives. Top radiator shutters insure proper engine cooling-water temperatures in cold weather. Traction-motor experience continues to be excellent, though improvements in ventilation are contemplated. A water pump by-pass arrangement has been applied to the steam generators and a method worked out to secure satisfactory operation in freight service (where the steam demand is low) without waste of fuel oil or water. In all of these projects the railroad has enjoyed the active cooperation of the interested manufacturers.

An item of particular importance in the maintenance of Diesel locomotives is keeping complete data for each locomotive and its parts, aside from the usual records used for accounting purposes. Possibly a better term to use would be "apparatus history.". This should include location and serial numbers of wheels, axles, trucks and traction motors; Diesel engines and various parts (including superchargers), generators, exciters, speed switches, and fan drive units; steam generators, including coils and auxiliaries; batteries, air compressors and all other major items of equipment. Dates of changes with locomotive numbers and a brief account of the reason for such changes should be carried under each serial number, or in such a way that the history and service experience of any given integral part may be easily traced. The importance of this in the maintenance of both electric and Diesel-electric locomotives cannot be over-emphasized.

Regarding the overall maintenance situation, the twenty 2,000-hp. units have accumulated, to the first of this year, a total of 4,886,908 miles; this is mostly on 157-mile runs. They have been in service since December 13, 1941, and six have already gone through Class 3 repairs. With this as a background, it is believed at this time that an average maintenance cost per unit per mile of \$.10, or \$.20 per mile per 4,000-hp. locomotive, is a reasonable top limit to set on overall maintenance on the basis of the present type of service.

Ten more 2,000-hp. units, or five 4,000-hp. locomotives, are under construction now, with delivery starting very soon, and beyond these, ten more similar units are in prospect. If and when these latter are received, there will be a total of twenty 4,000-hp. Diesel-electric road locomotives on the New Haven.

Heavy Grade Operation

One of the underlying reasons for the acquisition of more units was the result of tests conducted late last summer on the heavy grade freight route from New Haven, Conn., to Maybrook, N. Y. Freight traffic on this 125-mile line had increased many times and it was necessary to supplement the 2-10-2 Santa Fe type steam locomotives in that service. A large part of this traffic is

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The result of a crown-sheet failure, showing the condition of the locomotive before the jacket had been removed

Locomotive Inspection Report

Annual report of the Bureau of Locomotive Inspection for year ended June 30, 1943, indicates the effect of higher operating mileages and speed on the condition of power

THE annual report of the Interstate Commerce Commission Bureau of Locomotive Inspection for the year ended June 30, 1943, recently made public by John M. Hall, director, reveals a decided increase in the number of defects found on locomotives by the Bureau's inspectors. The total number of locomotives inspected increased from 113,451 to 116,647 and the number found defective increased from 10,970 to 11,901. The total number of defects found increased from 44,928 to 51,350. The report indicates an improvement in the fatalities resulting from accidents but a great increase in the number of persons injured.

Table I—Reports and Inspections—Steam Locomotives

	Year ended June 30					
	1943	1942	1941	1940	1939	1938
Number of locomotive for which reports were filed	43,064	42,951	43,236	44,274	45,965	47,397
Number inspected	116,647	113,451	105,675	102,164	105,606	105,186
Number found defective	11,901	10,970	9,570	8,565	9,099	11,050
Percentage inspected found defective	10	10	9	8	9	11
Number ordered out of service	487	474	560	487	468	679
Number of defects found	51,350	44,928	37,691	32,677	33,490	42,214

The report calls attention to the fact that under present conditions the desire to keep trains moving may be indirectly responsible for many accidents and suggests that the safer method of stopping and investigating defects or failures that may appear to be minor in character may save both equipment and lives.

An abstract of the report follows.

Explosions and Other Boiler Accidents

Twenty-five boiler explosions occurred in the fiscal year, in which 24 persons were killed and 56 injured. There was an increase of 12 accidents, an increase of one person killed, and an increase of 36 persons injured from explosions as compared with the preceding year.

One of these accidents, in which two persons were killed and 22 injured, was primarily caused by a collision in which the locomotive was derailed and came to rest leaning to the right and with the front end down an embankment. This position caused parts of the firebox to be bared of water which resulted in overheating. The explosion occurred about 10 minutes following the derailment after the engineer, who had previously alighted on the ground, had returned to the locomotive with the apparent intention of taking some action to prevent the overheating of the exposed areas of the firebox.

In one instance, in which two persons were killed and

Table II—Reports and Inspections—Locomotives Other Than Steam

	Year ended June 30					
	1943	1942	1941	1940	1939	1938
Number of locomotive units for which reports were filed	4,351	3,957	3,389	2,987	2,716	2,555
Number inspected	6,847	6,728	5,558	4,974	4,581	4,024
Number found defective	298	358	319	298	260	274
Percentage inspected found defective	4.4	5	6	6	6	7
Number ordered out of service	6	12	21	16	14	9
Total number of defects found	849	928	905	766	696	769

Table III—Accidents and Casualties Caused by Failure of Some Part of the Steam Locomotive, Including Boiler, or Tender

	Year ended June 30					
	1943	1942	1941	1940	1939	1938
Number of accidents	319	222	153	164	152	208
Percent increase or decrease from previous year	[1] 43.7	[1] 45.1	6.7	[1] 7.9	26.9	20.9
Number of persons killed	27	34	15	18	15	7
Percent increase or decrease from previous year	20.6	[1] 126.7	16.7	[1] 20.0	[1] 114.3	72.0
Number of persons injured	373	227	182	225	164	216
Percent increase or decrease from previous year	[1] 64.3	[1] 24.7	19.1	[1] 37.2	24.1	23.7

[1] Increase.

one injured, parts of all the firebox sheets were overheated due to foaming of the boiler water. In another accident, in which one person was injured, the explosion was caused by the failure of a fusion welded joint in a crown sheet patch. The remaining 22 accidents, in which 20 persons were killed and 32 injured, were caused by overheated crown sheets due to low water.

The serious results of boiler explosions are well known to railroad men and explosions have been materially reduced since the inception of the Boiler Inspection Act; however, there has been an increase in such accidents in the past three years with consequent increased loss of life and injuries and destruction of equipment. Increased vigilance of all concerned is necessary to overcome and reverse this trend.

Many locomotives are equipped with protective devices such as syphons, multiple drop or fusible plugs, and low-water alarms, all of which have no doubt prevented boiler explosions or minimized the severity thereof. Carriers that are continuing to make applications of devices of this character are making a distinct contribution to the conservation of human resources and equipment.

Boiler and appurtenance accidents other than explosions resulted in the death of one person and injuries to 117 persons; this is a decrease of six in the number of deaths and an increase of 52 in the number of injuries as compared with the preceding year.

One thousand and sixty-seven applications were filed for extensions of time for removal of flues, as provided in Rule 10. Investigations disclosed that in 49 of these cases the condition of the locomotives was such that extensions could not properly be granted. Eighteen were in such condition that the full extensions requested could not be authorized, but extensions for shorter periods of time were allowed. Forty-eight extensions were granted after defects disclosed by investigations were required to be repaired. Twenty-five applications were canceled for various reasons. Nine hundred and twenty-seven applications were granted for the full period requested.

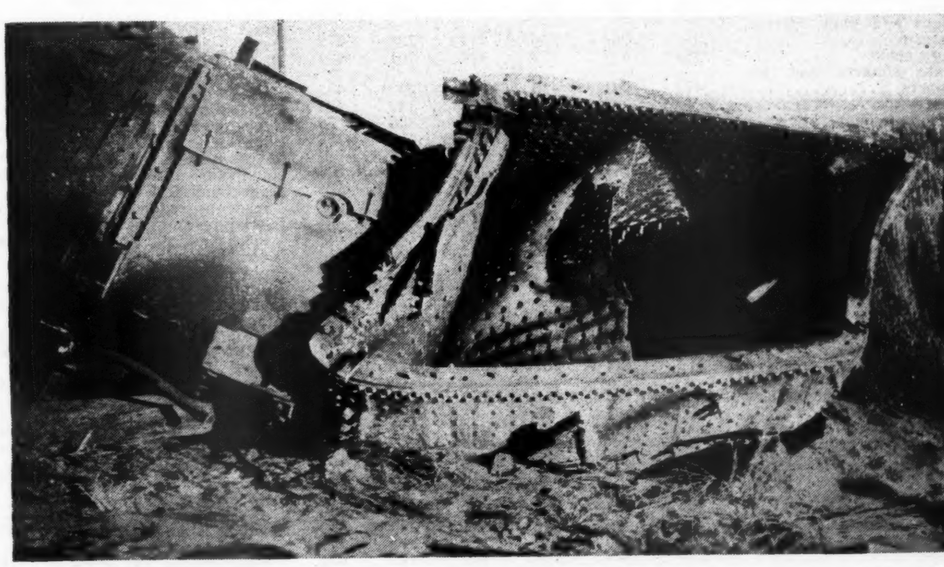
Table IV—Accidents and Casualties Caused by Failure of Some Part of Appurtenance of Locomotives Other Than Steam

	Year ended June 30				
	1943	1942	1941	1940	1939
Number of accidents	15	9	11	7	5
Number of persons killed	..	..	..	..	..
Number of persons injured	18	9	11	7	5

Locomotives Propelled by Power Other Than Steam

There was an increase of six in the number of accidents occurring in connection with locomotives other than steam and an increase of nine in the number of persons injured as compared with the preceding year. No deaths occurred in either year.

During the year, 4.4 per cent of the locomotives inspected were found with defects or errors in inspection that should have been corrected before the locomotives were put into use; this represents a decrease of 0.6 per cent compared with the results obtained in the preceding year. Six locomotives were ordered withheld from service because of the presence of defects that rendered the locomotives immediately unsafe; this represents a decrease of six locomotives compared with the next preceding year.



Another low water case resulting in a boiler explosion that caused the death of one employee and injury to two others. The crown sheet was torn loose at the door sheet welded seam and pulled away from all of the crown stays, inverting itself and folding back against the flue sheet. The mud ring was broken at the right back corner and driven 30 in. out of line in three directions leaving it, as may be seen, diamond shaped

Specification Cards and Alteration Reports

Under Rule 54 of the Rules and Instruction for Inspection and Testing of Steam Locomotives, 501 specification cards and 6,273 alteration reports were filed, checked, and analyzed. These reports are necessary in order to determine whether or not the boilers represented were so constructed or repaired as to render

safe and proper service and whether the stresses were within the allowed limits. Corrective measures were taken with respect to numerous discrepancies found.

Under Rules 328 and 329 of the Rules and Instructions for Inspection and Testing of Locomotives Other Than Steam, 432 specifications and 110 alteration reports were filed for locomotive units and 69 specifications and 97 alteration reports were filed for boilers mounted on locomotives other than steam. These were checked and analyzed and corrective measures taken with respect to discrepancies found.

Special Work

In response to requests from military and naval authorities and other Government agencies engaged in the war effort, inspections of various locomotives were made to determine the condition and suitability for use, and cooperative assistance was rendered in other respects. These locomotives are being generally maintained to the standards prescribed by the locomotive inspection law

(Continued on page 65)

Table V—Number of Steam Locomotives Reported, Inspected, Found Defective, and Ordered From Service

Parts defective, inoperative or missing, or in violation of rules	Year ended June 30					
	1943	1942	1941	1940	1939	1938
Air compressors	968	829	684	567	518	689
Arch tubes	50	27	31	20	28	66
Ashpans and mechanism	71	80	67	37	67	72
Axles	15	2	5	3	2	13
Blow-off cocks	291	238	205	191	204	226
Boiler checks	503	393	313	288	279	301
Boiler shell	377	290	271	266	272	331
Brake equipment	2,661	2,382	1,945	1,506	1,577	2,044
Cabs, cab windows, and curtains	1,102	1,163	1,087	1,078	943	1,226
Cab aprons and decks	390	335	307	277	260	326
Cab cards	142	131	97	101	92	109
Coupling and uncoupling devices	66	70	74	53	60	73
Crossheads, guides, pistons, and piston rods	1,961	1,273	858	815	739	905
Crown bolts	66	75	97	54	47	59
Cylinders, saddles, and steam chests	1,395	1,514	1,332	1,320	1,232	1,645
Cylinder cocks and rigging	430	521	438	447	418	585
Domes and dome caps	196	112	94	78	90	109
Draft gear	599	651	620	508	450	740
Draw gear	469	369	347	306	360	479
Driving boxes, shoes, wedges, pedestals, and braces	2,053	1,743	1,348	1,243	1,330	1,688
Firebox sheets	303	255	224	191	238	244
Flues	215	178	150	147	165	159
Frames, tail pieces, and braces, locomotive	894	869	863	665	708	1,001
Frames, tender	86	86	83	78	71	131
Gages and gage fittings, air	191	193	183	132	155	230
Gages and gage fittings, steam	316	263	236	211	226	279
Gage cocks	584	497	373	400	361	451
Grate shakers and fire doors	492	491	430	273	252	403
Handholds	483	378	433	333	349	405
Injectors, inoperative	66	47	39	30	26	26
Injectors and connections	2,637	2,220	1,882	1,330	1,457	1,784
Inspections and tests not made as required	9,037	8,186	7,215	6,218	6,645	8,204
Lateral motion	700	498	357	313	243	325
Lights, cab and classification	184	131	50	49	50	48
Lights, headlight	184	218	190	180	177	257
Lubricators and shields	292	234	196	185	200	212
Mud rings	256	244	187	213	248	203
Packing nuts	669	689	508	418	408	448
Packing, piston rod and valve stem	724	738	675	660	739	913
Pilots and pilot beams	194	188	142	140	104	154
Plugs and studs	259	173	156	156	179	238
Reversing gear	452	411	387	320	317	404
Rods, main and side, crank pins, and collars	2,798	1,986	1,565	1,199	1,293	1,669
Safety valves	74	67	68	61	97	125
Sanders	642	738	490	415	432	536
Springs and spring rigging	3,583	3,349	2,597	2,174	2,340	2,901
Squirt hose	92	67	62	50	75	94
Stay bolts	367	272	239	227	181	211
Stay bolts, broken	247	274	198	271	258	380
Steam pipes	414	290	385	255	285	410
Steam valves	159	150	110	106	115	141
Steps	729	594	555	449	490	631
Tanks and tank valves	1,321	1,150	952	768	837	955
Telltale holes	78	79	59	95	58	67
Throttle and throttle rigging	887	786	688	647	638	685
Trucks, engine and trailing	1,020	833	636	598	628	762
Trucks, tender	900	786	773	705	665	907
Valve motion	998	779	580	506	554	722
Washout plugs	685	569	445	478	487	626
Train-control equipment	9	7	1	2	5	11
Water glasses, fittings, and shields	1,454	1,133	788	753	690	915
Wheels	728	664	536	554	466	577
Miscellaneous - Signal appliances, badge plates, brake (hand)	1,142	970	785	564	610	684
Total number of defects	51,350	44,928	37,691	32,677	33,490	42,214
Locomotives reported	43,064	42,951	43,236	44,274	45,965	47,397
Locomotives inspected	116,647	113,451	105,675	102,164	105,606	105,186
Locomotives defective	11,901	10,970	9,570	8,565	9,099	11,050
Percentage of inspected found defective	10	10	9	8	9	11
Locomotives ordered out of service	487	474	560	487	468	679

Table VI—Number of Locomotives Other Than Steam Reported, Inspected, Found Defective, and Ordered From Service

Parts defective, inoperative or missing, or in violation or rules	Year ended June 30					
	1943	1942	1941	1940	1939	1938
Air compressors	7	13	22	8	14	6
Axles, truck and driving	6	..	5	..	1	5
Batteries	2	1	6	1	1	1
Boilers	1	5	4	10	6	6
Brake equipment	62	86	69	50	50	74
Cabs and cab windows	33	27	45	22	36	25
Cab cards	17	20	24	13	18	11
Cab floors, aprons, and deck plates	31	10	14	17	13	8
Clutches	2	1	..	..	..	..
Controllers, relays, circuit breakers, magnet valves, and switch groups	9	12	7	16	13	7
Coupling and uncoupling devices	1	5	2	6	4	4
Current - collecting apparatus	1	1	3	1	5	8
Draft gear	15	19	15	31	17	23
Draw gear	2	3	3	2	4	3
Driving boxes, shoes, and wedges	25	16	36	29	52	16
Frames or frame braces	7	5	1	12	9	37
Fuel system	32	81	62	51	35	47
Gages or fittings, air	3	8	3	1	6	11
Gages or fittings, steam	1	..	..	2	..	..
Gears and pinions	4	4	2	1	2	2
Handholds	19	14	12	6	8	13
Inspections and tests not made as required	223	274	243	207	185	204
Insulation and safety devices	4	3	4	2	4	13
Internal - combustion engine defects, parts and appliances	50	62	54	35	32	26
Jack shafts	2	1	3	7	6	1
Jumpers and cable connectors	3	1	..	..	1	1
Lateral motion, wheels	10	..	4	5	1	..
Lights, cab and classification	1	5	2	1	3	2
Lights, headlight	2	1	1	3	4	4
Meters, volt and ampere	3	2	..	4	2	2
Motors and generators	14	16	16	12	19	18
Pilots and pilot beams	4	10	12	10	6	1
Plugs and studs	..	..	..	..	..	..
Quills	9	6	..	4	7	6
Rods, main, side, and drive shafts	..	2	4	2	2	2
Sanders	41	57	56	34	28	37
Springs and spring rigging, driving and truck	18	35	58	50	16	43
Steam pipes	1	..	1	4	..	5
Steps, footboards, etc.	25	21	35	22	18	23
Switches, hand - operated, and fuses	2	2	2	3	5	7
Transformers, resistors, and rheostats	3	3	3	1	1	3
Trucks	22	28	30	43	33	40
Water tanks	4	1	1	..	1	..
Water glasses, fittings, and shields	2	5	1	1	1	3
Warning signal appliances	3	3	4	..	1	3
Wheels	107	43	28	22	16	11
Miscellaneous	16	14	8	15	10	7
Total number of defects	849	926	905	766	696	769
Locomotive units reported	4,351	3,957	3,389	2,987	2,716	2,555
Locomotive units inspected	6,847	6,728	5,558	4,974	4,581	4,024
Locomotive units defective	298	358	319	298	260	274
Percentage inspected found defective	4.4	5	6	6	6	7
Locomotive units ordered out of service	6	12	21	16	14	9

Efficient Railroad Operation Involves Many

Car Department Responsibilities*

By A. J. Krueger †

The operation of the railroads today revolves primarily around a condition influenced by the conditions arising out of the war and which carries with it the otherwise normal requirements demanded of the railroads in recognition of the fact that they are the prime transportation agencies of our country today. The war alone has caused some strange conditions to arise and has produced an upheaval foreign to our regular operation and has raised a challenge which the great railroad systems of our country must meet. This challenge has been eagerly accepted and it has been met.

The car department is a vital and indispensable part of our complicated and efficient railroad structure. A knowledge of the manifold duties of the car department establishes its essential character. Its primary functions are concerned with the proper inspection and repair of both freight and passenger car equipment. In the performance of these functions the car department reaches far into the railroad organization and is brought into intimate contact with railroad personnel ranging from the chief mechanical officer to the laborer. In the discharge of its duties and responsibilities the car department provides for and executes many factors, among which are:

Organization.
Maintenance, including light and program repairs.
Inspection, including train yard and interchange.
Improvements in methods of performing work.
Lubrication.
Creation of and increased use of special equipment.
Shop facilities and labor saving devices and methods in keeping with present day man power situation.
Administration of the A. A. R. Rules of Interchange.
Wheel shop practices.
Job training and competent instruction.
Maintenance costs.
Improvements in design and additions and betterments to equipment.
Employee relationship.
Deferred maintenance and equipment retirement policy.
Postwar planning.

The underlying thought or theme which manifests itself in the duties and responsibilities of the car department in the operation of today's railroad is the ability and important function of that department in keeping pace and in step with the rapid progress being made in improving train schedules and a general speeding up of traffic created by the demands placed upon the railroads for such operation. For the railroad industry wherein such accomplishments are being executed and concluded the car departments through their departmental organization and operation must adjust their practices and methods. We must also give thought to and contemplate the necessary readjustment, improvements and changes required in the anticipated postwar operations about which some expressions in connection therewith are pointed out in this paper and which I feel definitely becomes part of and an added responsibility of the car department.

Competent inspection of cars is of the utmost importance and is the constant objective of the car department. Thorough and intelligent inspection of cars means a substantial reduction in the number of bad order cars in trains which must be set off between terminals and a decrease in accidents. These results are their own reward and impose confidence in the transportation and operating departments in the ability of the cars to perform satisfactorily and so make possible the speed of movement which is so vital today. Inspection procedure is not hidebound. It is in a state of flux. It is continually being modified to adapt it to changing conditions and to meet the varying requirements of the ever increasing demands of changing schedules, rerouting of traffic and higher speeds. Inspection is divided into two classes, interchange inspection and train yard or terminal inspection.

Interchange Inspection

The duties of an interchange car inspector are many and varied and are highly important to safe operation. Proper protection of cars received in interchange with defects for which the delivering road are responsible and general knowledge of many rules and regulations covering the operation of freight and passenger cars in trains are required. An interchange inspector should, preferably, have had at least four years' experience as an apprentice or carman and must have a fair knowledge of all rules governing the work to be performed by him. He must be familiar with the A. A. R. Rules of Interchange, the United States Safety Appliance Rules, air brake rules and the maintenance of brake and train air signal equipment, car service rules, special instructions, carding of empty cars, record keeping, safety rules, the Wheel and Axle Manual, the use of wheel defect, worn coupler limit, worn journal collar and journal fillet and other gauges, and the proper application, use and billing of equipment, tools and supplies.

Summary of Interchange Car Inspector's Duties

An interchange inspector is responsible for:

1. General Class "A" inspection of all parts of a car, including the interior, if the car is empty.

2. Inspection of journal boxes and contained parts, including adjustment of packing and application of free oil if necessary.

3. Making repairs where possible or shopping car when more extensive repairs are required.

4. When car has defects for which the delivering line is responsible issuing defect card against the delivering line, applying cards to car and furnishing copy of same to delivering line.

* An abstract of an address delivered before the Eastern Car Foreman's Association at New York on January 14, 1944.

† General superintendent car department, New York, Chicago & St. Louis, Cleveland, Ohio.

5. When repairs are made which are chargeable to the car owner, making of billing repair card in duplicate showing repairs made and forwarding original to billing office and duplicate copy placed in record file.

6. In the case of empty freight car equipment, if car is found to be in serviceable condition, commodity cards are applied to both sides of car showing the classification of commodity for which cars are suitable. A report of all such cars is forwarded to the various parties concerned.

7. In the event of empty cars of foreign ownership having major defects which require repairs before reloading, bad order cards are applied to each side of car and the car is forwarded home to car owner or disposition is requested if car does not have direct connection with car owner.

8. In the case of loaded cars, such loads, if in open top cars, must be inspected to determine if loaded in accordance with the A. A. R. Rules governing the loading of commodities in open top cars, special supplement covering the loading of mechanized and motorized equipment, etc.

9. Cars found improperly loaded are shopped to designated repair point for correction or held for special disposition in the event of excessive height and/or width which will not pass the published clearances.

10. If a car inspector finds a car which appears to be overloaded in excess of stencilled load limit or track capacity or finds a concentrated load which seems in excess of the weight permitted by the rules, the inspector shall notify the designated official so that the bill of lading or waybill may be checked to determine if car is overloaded, or in excess of track capacity. This is very important.

11. Cars of unusual design or not conforming to A. A. R. standards as outlined in the A. A. R. Rules of Interchange, Rule 3, must be reported to designated railroad officer, giving all details in regard to construction, weight, type of trucks, etc., and dimensions, if in excess of published clearances, advising whether or not cars should move under special handling with speed restrictions or in a specific location in the train. The above procedure to be followed in the event cars of such type are received without advance notice and approval.

12. When regular work permits they should observe cars in passing trains to detect any mechanical defects that might cause train delays, derailments, etc., and take action to notify train crews or dispatcher.

Train Yard Inspection

A terminal train yard inspector should preferably have had at least four years experience as an apprentice or carman and should have a fair knowledge of the English language and be able to read and write. He should also have a general knowledge of various rules as outlined in detail for interchange inspectors.

Terminal train yard inspection consists principally of what is commonly called Class "B" Inspection. Upon the arrival of a train in a terminal yard a general and careful observation is made of cars, primarily to detect defects that may have developed since the last inspection at an interchange point or preceding terminal. Special attention is given to trucks, draft gears, couplers, air brakes and safety appliances. When air brakes have been left applied piston travel is observed and adjusted where necessary. In some cases, Class "A" inspection is necessary for cars which may have been picked up at outlying stations where no inspection was made and where notice had been received in advance, requesting inspection of such cars.

The method of inspection of trains at various terminals varies. In some cases trains are inspected before being switched and in other cases inspection is made after the train is completely made up and ready for departure. In the latter case, it is usually customary to make the inspection and standard air brake test at the same time. As far as possible, inspectors should observe arriving trains from both sides to detect any cars with wheels pounding, brake beams down, stuck brakes, etc., which defects might possibly be overlooked after the train has come to a stop and air brakes have leaked off or defects are concealed. Before beginning inspection, trains should be properly protected with blue flags or blue lights so that inspection can be made with safety to the men.

Cars found in trains with defects which should be repaired before departure should have repairs made by the inspector if it is possible to do so, or be shopped to a repair track for repairs. In the case of some defects, good judgment is required in this respect as repairs might be made to car without delaying a train unnecessarily and avoid the switching of car to repair track, causing additional delay to shipment.

Loaded open top cars should be observed carefully to determine if the lading has shifted, bracing or blocking loosened or broken on arrival or after switching and if it is loaded in accordance with A. A. R. Loading Rules. Classification of empty cars is required when cars are found in trains which have no commodity cards showing commodity for which car is suitable.

After completion of inspection, when train is built up or in connection with inspection on trains where switching is done before inspection, a standard air brake test must be made to observe that air brakes are in serviceable condition, knowing that the air brakes on each car have set and released properly.

It is necessary for the terminal train yard inspector to make all necessary reports such as train time arrival, time inspection and/or air test started and completed and time of departure. Billing repair cards should be made for all repairs made to cars of foreign ownership which are billable in accordance with A. A. R. Rules. Records and reports must be made of empty cars which have been classified for loading. They should be made on designated forms giving all information necessary in connection with cars bad ordered to repair tracks. In the case of loaded bad order cars this information is also transmitted to both the general yardmaster and repair track so that every effort is made to have car placed on repair track promptly and repairs made with the least possible delay. Cars containing military shipments, explosives, etc., must be given a closer inspection than is usually required of ordinary trains or cars.

It is very important that material, tools, etc., be conveniently located in material boxes or buildings close to or adjacent to where train yard work is being performed so as to avoid any unnecessary delays in securing material to make repairs. A standard stock of all items of material commonly used should be kept on hand at all times, together with necessary tools.

The successful operation of train yard inspection where the methods of inspection of all trains are not similar, depends considerably upon the cooperation between the transportation department and car department relative to the manner in which each train is to be handled and inspected.

Car repair is a complex undertaking. It reaches far beyond the actual mechanical operations of repair. It involves such matters as switching, arranging programs of heavy repairs through the shops, scheduling materials,

obtaining priority ratings, substituting materials, organization, facilities, supervision, training of men, and many other matters embraced in light, running, medium or program repairs.

Intensive study is being devoted to this important problem of repairs. Uniform methods of repair and improvement in design are being developed. Information regarding these methods is disseminated freely so that all of the railroads can benefit from their knowledge and experience. In no other period in the history of the railroads has it been so vital to quickly find the solution of problems and thereby to promote the efficient operation not only of the mechanical department, but of the transportation and traffic departments as well.

I should like at this time, in a spirit of helpfulness, rather than of criticism, to refer to what I believe to be matters of major importance for the consideration of representatives of the mechanical departments of the railroads. These matters relate to:—

1. The conservation of equipment through proper use. This involves, in part at least, the correct distribution of equipment on the basis of commodity classification as indicated by the reports of mechanical inspectors;

2. The expeditious movement of all classes of freight car equipment when found defective to repair shops so that quick and complete repairs may be made. This contemplates a minimum of shopping of equipment and a reduction in the failures of cars while enroute; and,

3. Increased cooperation between the mechanical and transportation departments to bring about a smoother and more effective operating arrangement, particularly in train yards as it affects inspection, air brake tests, switching and the make-up of trains.

Proper commodity classification of equipment is of extreme importance in the proper distribution of equipment for the correct furnishing of cars on specific orders for loading. This makes it possible to meet competition satisfactorily to the shipper and above all to reduce the hauling of empty cars resulting from the mis-application of cars on orders where information regarding commodity classification of equipment is not utilized by the transportation department.

Inter-departmental cooperation, so highly essential to the attainment of the goal in view, requires for its achievement the removal of any invisible barriers which may manifest themselves. Productive cooperation must be grounded in a spirit of harmony, understanding and tolerance. In such an atmosphere the car department can do its job fully and efficiently for then there would be made available by the transportation department satisfactory information regarding train yard operation as it relates to the arrival of trains, the number of cars in a train, the manner in which it is intended to handle trains upon arrival, together with the preference of the operating department in work to be done. Frequently conferences at the scene of activity between local supervisors of both the mechanical and transportation departments and proper information in all phases will do much to further the effectiveness of the work to be accomplished.

Full recognition must be given to the ever-growing necessity for the quick movement of equipment between railroads. This is particularly true of those railroads whose interests are closely allied by virtue of operating, traffic and inspection arrangements. This movement of equipment is even now being obtained in some degree by the initiation of certain practices relating to the inspection of equipment, advance submission of consists by the delivering railroads and increased efficiency in switching at certain locations. But much yet remains to be done and quick movement of equipment between railroads can be further advanced by understanding, cooperation and study on the part of the railroads. This suggestion is offered in the expectation that it will receive thoughtful consideration which will prove to be fruitful.

Today we are loading our cars more fully and operating our trains faster, thus causing more work and more extensive repairs to be needed than was formerly necessary. Car parts are failing and causing trouble which under ordinary conditions gave satisfactory service. In addition to this there is a wide variety of special loads to be transported. As a whole, the car departments of the railroads have operated satisfactorily and maintained a constant high standard of maintenance notwithstanding the critical shortage of man power.

Looking at the Future

It is felt, however, that we should at this time survey the present and anticipate the future outlook and requirements. There are many problems which will have to be answered as far as our rolling stock equipment is concerned if we expect to compete with other various forms of transportation, such as the private automobile, highway truck, bus and airplane. In my estimation the major items which will have to be contemplated are the increased speeding up of freight movements and improvements in passenger service. There are many locations which require better and quicker service and it will be necessary to run freight trains in the future at a speed which only a short time ago was considered a fast passenger train schedule.

Serious and intensive study should be devoted to improvement in the design of those parts of rolling stock equipment which must be charged with the major portion of the responsibility for delays, accidents, derailments, and personal injuries. I refer to such parts as, air brake piping and its method of anchorage, brake beam and truck brake rigging, couplers, draft gears and coupler stops, wheels, and cast-steel truck side frames.

I am not now recommending that still serviceable parts of rolling stock equipment be removed from service merely because they have been in use for 20 years and improved parts are available. However, we must realize that such antiquated parts cannot withstand the present severe service requirements, especially when loads in freight car equipment have increased 40 per cent since 1920. Unless something is done, continued failures of such parts must be expected. But regardless of the type of equipment it has been found that the largest percentage of delays, accidents, derailments, and personal injuries are attributable to these parts. The crying need for improvement in them is clear.

Attention must also be focused upon the administration of the Loading Rules. This is a matter of deep concern and its importance cannot be too greatly emphasized. Inadequate enforcement of these rules lies at the root of delayed shipments on account of overloading, improper blocking and bracing, and, in the case of concentrated loads, the restriction of loads compared to the total load limit of the car. This latter item is particularly annoying to the transportation department and to the traffic department as well. This lamentable situation calls for correction. More intensive study and training of personnel is suggested as an aid to the proper enforcement of the Loading Rules. This burden imposed on supervisors may be so great that they find it impossible to devote the time required to fully administer the Loading Rules. Perhaps the most feasible solution lies in the

selection of certain employees from within the organization of the various railroads who through necessary study would become specialists on the Loading Rules. These specialists would then promulgate procedures and publish records which would assure us that the Loading Rules are being properly enforced and enable us to explain confidently the need for restricting certain loads or insisting upon compliance with the Loading Rules.

Special Equipment

The railroads are and will be faced with potential competition and to maintain their present position in the transportation field must produce not only efficient but economical transportation. Doing this involves not only savings in time enroute and reduced loss and damage but the introduction of special equipment for handling foods, automobiles, airplane parts, motors, machinery parts and other special ladings. Such demands can be met by designing equipment having a certain flexibility making it possible to utilize the equipment to the fullest extent possible. The railroads should consider such equipment in the light of the volume of the business which can be obtained. They should keep alive and active a competent engineering staff for the development of such equipment in connection with ordinary regular day to day staff problems. Cooperation between the traffic departments, specialty manufacturers and car builders will be needed to work out special shipping and equipment difficulties with the end in view of increasing revenue for the railroads.

Changes in New Car Designs and Improvements in Existing Equipment

The car department officers through constant association with repairing and maintaining cars are in a better position to improve the design of cars than any one on a railroad, for the reason that as the cars go through shop for repairs they become familiar with the weaknesses which may develop fom time to time. Alert supervision takes advantage of this experience and knowledge in seeing to it that these weaknesses and defects are overcome in future designs. Not only should this subject be studied with a view to improving the designs of cars but also to change the design when necessary so as to make the design of car easier to maintain. The engineering department relies to a great extent on the car department for information in connection with that which would make for a better car from a strength standpoint and also an easy car to repair and maintain, and unless car department supervision is constantly on the alert it will not play the role its duty calls for.

Our postwar program should include giving consideration to certain modernizations and a thorough, continuous search for improvements in the design of machinery, motive power, rolling equipment, and in some of our actual practices as they exist today which have not been found sufficiently adequate and in which there is a marked degree of improvement necessary.

Specific suggestions for improvements are:

1. Develop designs for easy riding, shock-absorbing, high-speed trucks for freight car equipment
2. Establish competent research facilities and undertake specific measures to improve the hot box situation, even to the extent of improving the character of the oil, the type of packing, the method of lubrication and the design of the trucks, together with such other improvements, either in the car or truck itself which might become necessary
3. Continue our study in the development of certain car parts to meet present day operating conditions to avoid failures of equipment enroute and in switching yards; such as, couplers, wheels, journals, train lines, brake rigging, and all items of this nature which if improved will go a long way toward increasing the efficiency of the railroads, to avoid bad order cars and delays to shipments enroute.

The car departments of the railroads can and should operate in harmonious unity with all related departments and render the required service and assistance necessary to the successful operation of our railroads. In accepting these duties and responsibilities they can help to produce such results through whole-hearted cooperation with the Association of American Railroads.

Diesels in Road Service

(*Continued from page 57*)

handled through by way of the Shore Line to and from Providence, R. I., and Boston, Mass., so that Diesel-electric locomotive runs from Maybrook to Boston and return were a possibility, given a locomotive suitable for both the Shore Line and the Maybrook route.

Previous calculations had shown that the 80 m.p.h. geared 4,000-hp. locomotives between New Haven and Maybrook could handle 2,000 trailing tons westbound and 3,800 trailing tons eastbound, as compared to rated tonnages of 2,000 and 4,000, respectively, for the steam locomotives.

If these calculations could be confirmed by actual service results, the possibilities were extremely attractive since Maybrook motive power could be augmented by Diesel-electric locomotives identical with those already on the Shore Line, thus expanding the scope of Diesel-electric operation and bringing to the Maybrook route the economies and advantages of such operation.

On August 31 and September 1, 1943, test runs were made between New Haven and Maybrook. On the first day, trailing tonnages somewhat under the calculated figures were successfully handled, and on the second day tonnages were increased to 1,840 in 80 cars westbound and 4,006 in 67 cars eastbound. On the basis of these runs, the railroad's and manufacturers' representatives felt that not only had the calculated tonnage ratings been confirmed, but that the eastbound figure could be increased to 4,000 tons, thus making rated trailing tonnages both eastbound and westbound the same for the Diesel-electric locomotives as for the 2-10-2 type steam locomotives between New Haven and Maybrook.

On a heavy grade route, particularly in freight service, traction motors are generally the limiting feature. Hence, the performance of the 80 m.p.h. geared traction motors on the tests described was very carefully observed. But let me say at this point that when you are on a test run and speed begins to drop while traction motor current increases up to and then beyond the continuous rating, with the top of the hill nowhere in sight, calculations and curves have a way of fading and you are left just hoping for the best.

Another element of doubt was resolved by the test runs to Maybrook. This was pushing a Diesel-electric-hauled train up Hopewell Hill with a 2-10-2 steam locomotive, such pusher service being regular procedure with steam locomotive operation. This was successfully done, however, which means that the load was satisfactorily divided between the Diesel-electric locomotive at the head end and the steam locomotive at the rear end.

It is by means of steps such as these that the use of new types of motive power is enlarged and extended. In the case of the New Haven, this could be called Chapter II of Diesel-electric locomotive operation in road service.

Predictions for the future are always risky and result eventually in the prophet being judged either foolish or farsighted, with odds on the former. Certain present tendencies, however, point to possible developments which must at least be considered at this time.

The number of higher speed, lighter weight Diesel engines will increase. Weight saving will be important if it results in lowered first costs and elimination of idler wheels; if it results in increased maintenance, a line must be drawn at the point where other advantages offset this disadvantage. In freight service, the burden of proof should be on the builder to justify reduction in engine (and power plant) weight if it results in ballasting of the locomotive to obtain the desired tractive force.

It seems desirable in future Diesel-electric road locomotive design to aim for reduction in the number of individual units comprising a locomotive, and in the total number of separate power plants in that locomotive. Probably the ideal solution ultimately would be a single-cab locomotive with two power plants.

The possible future scarcity and probably increased cost of Diesel fuel oil may seriously affect the Diesel-electric picture as it is today; it will undoubtedly lead to efforts to increase engine efficiency and possibly the efforts to burn a cruder grade of oil.

Technological improvements in engine and locomotive parts and materials seem inevitable after the war, with consequent advantages to the user of Diesel-electric equipment.

Somewhat along this line is the gas turbine locomotive which, though still in the experimental stage, is receiving an increasing amount of attention on the part of engineers. Its chief advantage at present is its use of crude oil for fuel (and possibly powdered coal in the future) and its disadvantage, considerably lower thermal efficiency than is attained by the Diesel engine. With electric drive it became a competitor of the Diesel-electric locomotive.

But returning to the present, and in conclusion—Diesel-electric locomotives in main line freight and passenger service on the New Haven have demonstrated beyond any question their overall utility in exacting service under wartime conditions. They have, as a matter of fact, had the effect of increasing the capacity of the railroad between New Haven and Boston. Having done all this economically, reliably and efficiently, they leave no doubts as to their continuing value to the New Haven in the future.

Locomotive Inspection Report

(*Continued from page 60*)

and rules governing the condition of locomotives used on the lines of common carriers and inspections are currently made by our inspectors.

The condition of locomotives in use at the beginning of the upturn in railroad traffic was as good as ever recorded which in turn resulted in the highest degree of safety of locomotive operation ever attained. Increasing traffic required the placing in use of a large number of old and practically obsolete locomotives which had been in dead storage for periods ranging up to 10 years or more. These locomotives were repaired and placed in reasonably serviceable condition for the character of service for which they were designed but, lacking many modern features, they were not capable of rendering the performance found necessary under present circumstances without unusual precautions being exercised in inspections and the application of repairs to various parts much more frequently than is required for more modern locomotives. This condition and the increasing intensive use of all locomotives, coupled with the shortages of manpower and suitable material with which to make prompt and substantial repairs, has resulted in wear taking place faster than it can be restored and in turn often results in neglect to repair what may appear at the time to be an insignificant defect to an unimportant part, the failure of which, however, may start a chain of events leading up to delay in traffic and loss of life or limb.

Increase of manpower employed on locomotive maintenance will not within itself be of much assistance in solving the maintenance problem unless a reasonable proportion of this increase is skilled in the various crafts involved and sufficiently experienced to be able to exercise good judgment; in other words, there is a practical limit to which skilled labor can be diluted if benefit from the efforts exerted is to be obtained.

Inability to obtain a sufficient number of new locomotives and scarcity of suitable material and new parts with which to make substantial repairs to existing locomotives results in attempts to get the last possible mile out of all parts in which wear or deterioration has developed. This condition contributes to increase in breakdowns, delays, and accidents and has the further effect of diverting skilled labor to reclamation of used parts that would otherwise be discarded and replaced with new parts which would remain in serviceable condition longer, and which in many instances would cost less in manhours for preparation and application.

It is apparent that the supply of new locomotives for domestic railroads will not be sufficient to fill the current and prospective needs, and in view of this it is of paramount importance in the continued functioning of the railroads, in the expeditious production of new locomotives that can be wholly depended upon to perform their intended service, and in the interest of safety, that changes in design of the component parts thereof, materials, construction methods, processes, and established practices of the builders and the railroads be held to a minimum until the cessation of the war.

The exigencies of railroad service are such that all employees responsible for train movement are under constant pressure, some of which is self-imposed because of the nature of their training, to avoid train delays with consequent disruption in the orderly flow of traffic. It is inherent in the nature of the service that the motive is always present to keep trains moving not only to prevent train delays but also to avoid possible criticism or discipline for failure to do so. This condition is accentuated under present conditions because all involved realize that speed is the essence of today's production and delivery. As a consequence trains are at times kept moving until a major failure occurs instead of stopping and investigating any untoward indications which may momentarily appear to be of secondary importance. No considerable number of accidents of this character occur on any one railroad; however, considering the railroads as a whole, they are not uncommon. Many of these accidents would undoubtedly be avoided if the urge to keep trains moving was not temporarily permitted to take precedence over the usually recognized fact that undue haste often makes great waste.

EDITORIALS

Getting More Out of Passenger Cars

For many months now the railroads have been handling a volume of passenger traffic far in excess of anything they have been called upon to deal with in years and they have had to do this job in the face of a complete stoppage of passenger car construction. This has meant that every car the railroads own must be kept rolling every possible hour of the day. To accomplish this the passenger train terminal and car repair yards have borne the brunt of speeded-up inspection and servicing. How has this been done? What are the new tricks in management, facilities or methods that have been developed in your terminal or car yard? We're looking for the answer for our Roundtable discussion in the March issue and we'd like to have your comments as soon as possible, in any event, not later than February 15.

The Strain Is Telling

Conversations during recent weeks with a number of men of supervisory rank in the mechanical department lead us to believe that the burden which so far they have carried so well may be having an effect of which even they are not yet aware. To say that they are now beginning to *accept* failures in motive power and rolling equipment would be putting the matter too strongly. But there is in our mind a growing feeling that they are beginning to *expect* failures. This, we believe, is the cumulative result of several years of material shortages, manpower difficulties and a never-ceasing demand for production in the face of these problems.

Before the pressure of wartime traffic became so great these men would not have thought of saying, "You've got to expect a failure now and then." They understood that failures might occur but they didn't expect them because they had full confidence that the materials and workmanship going into their work were of such a character that they need feel no great concern. Today, with many skilled men gone to the armed services or to other industries; with material shortages only beginning to ease up and with shop equipment and machine tools being worn out as never before, it is true that many of them are saying, "We're doing the best we can."

Lately there have been signs that even in Washington there are those who are becoming aware of the fact that the railroad situation is critical and that our efforts to prosecute the war to an early end depend to a large extent upon the maintenance of railroad transportation at the highest *possible* level. This objective can be attained if action is taken to enable the roads to retain trained mechanical workers and furnish them with the materials and facilities with which to work.

The railroads need more locomotives, more cars, more men and more materials, and they need them now. We're convinced of that when railroad men begin to expect failures.

Excellent Safety Record, But—

The annual report of the Bureau of Safety of the Interstate Commerce Commission, insofar as it applies to mechanical department responsibilities, indicates that conditions found during this last peak year of traffic were not greatly different than those in more normal years. There was a slight increase over 1942 in the percentage of cars and locomotives inspected which had safety appliance defects requiring correction; however, the percentage was 0.03 less than in 1941. There was a marked decrease in the percentage of defective safety appliances on passenger cars and locomotives; the increase was entirely in the freight car field. The report indicates a highly creditable performance on the part of the mechanical departments. With 1943's official figures comparing favorably with those for 1941 we have good evidence that, despite manpower and material difficulties, the determination exists to maintain the usual high standards of safety in the inspection and repair of motive power and rolling equipment.

Percentages make a useful basis for comparison but they fail sometimes to give a completely true picture of existing conditions. As an example, consider the train-brake test figures given by the Bureau. For the

ast four years 99 per cent of the cars in departing rains and 98 per cent in arriving trains have been eported as controlled by air. This, too, represents n excellent performance, one which has been bettered n earlier years but a very good one nevertheless on percentage basis. It must be pointed out, however, hat in 3,559 trains inspected when ready for departure t was necessary to set out 1,574 cars and to repair ,053 others. This was done after the railroad inpectors had pronounced the trains ready to move. Thus, although the Bureau's report lists only 6 cars vithout air, 23 with brakes cut out and 144 on which rakes would not apply, actually in the 3,559 trains nspected there would have been, lacking the I. C. C. nspection, 3,800 cars without proper brakes. If this atio holds generally true about 1 in every 42 cars eaving freight yards today does so without the air rakes in proper condition.

Interpreted in this way the percentage total—99.58 per cent reported as operative in 1943—seems less important. It should not be too hard to find one bad car in every 42 if inspectors are properly trained and he transportation department can be prevailed upon o allow adequate inspection time. Figures don't lie, but they can give a false feeling of security or cause a glow of self-satisfaction when so expressed that hey indicate that a near-perfect job is being done; properly analyzed, however, they frequently point the way to still greater improvements in performance.

Circular Fluorescent Lamps

Ever since the development of fluorescent lamps for general lighting, users have expressed a desire for a fluorescent source which was not a straight tube; something that could be used by itself to light a rectangular area and be placed in some kind of an ornamental fixture of relatively small dimensions. To a very limited extent this requirement has been met by the use of cold-cathode tubes, but each installation has had to be tailor-made.

Now the manufacturers of Mazda lamps have announced that circular type, hot-cathode, fluorescent lamps will be made, "as soon as conditions permit." They will be made in three sizes, having outside circle dimensions of 8½ in., 12¼ in. and 16 in., and will be rated respectively 20, 30, and 40-watts.

The announcement is apparently made for the guidance of designers who may wish to include the lamps in their postwar plans. Their extended use in the railroad field seems improbable. In car lighting, the long, straight light source is inherently well suited to the long, low-ceilinged interior of a passenger car. The circular lamps might be used to advantage in compartments, bedrooms, roomettes, etc., but the special needs of such facilities have been met by a number of small incandescent sources. The circular lamp would seem to be well adapted to vestibule lighting, but because of possible hazard introduced by stroboscopic effect, fluorescent lamps have not found favor in this application.

In shop and office lighting it is usually necessary to use fluorescent lamps in multiples since the largest size is only 100 watts and in most applications of this kind it will probably prove easier to use the straight tubes in groups. The manufacturers have, however, taken steps to meet a demand. In many instances the circular lamps will permit an installation to be all-fluorescent where otherwise some incandescent would be used, and they will assist in rounding out a line of lamps which has revolutionized the lighting industry.

A Few Points On Painting

Among other spectacular features of one of the world's most formidable new 45,000-ton battleships, the U. S. S. Missouri, recently built at a cost of about 100 million dollars, is the fact that 312,000 lb. of paint were required to cover this imposing mass of steel. Certainly railroads use nothing like such an amount of paint on any one piece of equipment, or even building, yet, in the aggregate, they apply many times that amount annually on locomotive and car equipment to protect it from the elements and maintain appearance standards.

Some unusually interesting and pertinent facts about paint were emphasized in a paper before the December 6, 1943, meeting of the Northwest Carmen's Association at St. Paul, Minn., by D. R. Manuel, vice-president of the Frost Paint & Oil Company. In presenting the subject, "Paint and Its Uses," Mr. Manuel described the principal ingredients and methods of making paints and showed how quick-drying paints which permit applying two coats in one day fit into the demand for shorter equipment painting schedules. In fact, synthetic or alky-d types of mineral red finishes are available which dry even faster and are said to stand up even longer in service, particularly on steel sheathing. While these synthetic types of paint are largely unobtainable at present, they will be back after the war, probably in better quality and at attractively lower prices to meet railroad requirements.

Considerable hope is held out for a new processed linseed oil which has been treated so that a large proportion of the oxidation, or drying, has already taken place before application of the paint. Car paint utilizing this vehicle is said to dry quickly with controlled penetration and durability as good, or better than, synthetic paints. One advantage of this specially treated linseed oil is that it involves no use of critical materials.

Mr. Manuel is authority for the statement that the postwar era will bring revolutionary changes in railway equipment painting which will permit painting and stenciling cars, for example, in a fraction of the time required at present. He says it is not fantastic to visualize a straight-line system whereby cars are automatically sprayed with a baking type of synthetic enamel, followed by an 18-min. bake under infra-red lamps, then passing to a second automatic spray, a second bake, a stencil, a third bake, and then out of the shop.

There are some possibilities of a plastic material which, when baked on steel, will outlast the metal itself. With new and more versatile types of resins and synthetic finishes available at moderate cost, improved protection and appearance of car interiors also are promised. Especially treated plywood which will be practically moisture-, stain- and vermin-proof, is rather definitely in the picture of the not-too-distant future for inside lining. A large proportion of box-car floors fail owing to mechanical abuse, but as many, if not more, have to be renewed on account of oil and various commodity stains which, in many instances, cannot be removed and which render the car unfit for first-class loading. This condition may be largely prevented, or sometimes corrected, by the use of special finishes or cover coatings now showing more or less successful results under severe service conditions.

Three points, especially stressed by Mr. Manuel are well known, but certainly deserve the emphasis of repetition: (1) paint should be purchased *up* to a standard and not *down* to a price, as in paint, like everything else, we generally get about what we pay for; (2) do not skimp on the use of paint as an extra coat can be applied at nominal cost and a thin film of paint is hardly better than no paint at all; (3) prepare the surface carefully before painting in order to conserve valuable materials and man-hours as well as the equipment which needs protection.

In urgent times like the present when maximum locomotive- and car-miles a day are a fundamental consideration, it is difficult to hold equipment out of service long enough to make essential repairs let alone maintain paint standards. Nevertheless, as much of this work as possible should be done currently and plans deevloped to make up the deficiency just as soon as opportunity offers.

NEW BOOKS

PLASTICS CATALOG—1944. *Published by Plastics Catalog Corporation, 122 East 42nd St., New York. 989 pages, 8 in. by 11-¼ in., 8 charts, illustrated. Price $6.00.*

This is the catalogue of an industry which has seen remarkable growth during the war years and which will have an important place in post-war industrial economy. It contains basic information concerning plastic materials and the methods of their manufacture and fabrication. Many potential peacetime uses are indicated in the war applications described. The charts are especially valuable in providing details in a convenient form for study or comparison. A section is devoted to specifications of and tests for the various materials. Most of the standards set by the American Society for Testing Materials are given in either complete or abstracted form.

While much of the text material is of interest only to members of the industry, the catalog will serve all users or potential users of plastics as a valuable reference work and a guide to sources of any further information which they may desire. It includes a complete directory of the industry with an alphabetical list of every known factor and supplier of plastic products. The glossary of terminology published as a part of the Catalog serves admirably to acquaint the reader with terms and definitions peculiar to the industry. Excellently indexed, the volume probably contains all information which any but the most technically-minded reader needs to know concerning plastics.

MACHINERY'S HANDBOOK. *12th edition. Published by the Industrial Press, 140-148 Lafayette Street, N. Y. 1,815 pages, 5 in. by 7 in., 1,310 illustrations. Price $6.00.*

Most readers have become acquainted with Machinery's Handbook through actual usage, therefore, this review deals primarily with the outline of some of the important revisions or additions to be found in the 12th edition. The following summary includes additions of interest primarily to those in railroad mechanical work; many other additions and revisions of greater interest to those in other industries are also included; miscellaneous additional formulas relating to strength of materials and other designing problems; Class 5 screw thread fits for threaded steel studs as approved for federal services; standard grinding-wheel markings adopted by the Grinding Wheel Manufacturers' Association to indicate abrasive grain size, hardness or grade, structure or density and bonding process; American standard thread gage and plain gage tolerances; manufacturers' standard gage for sheet steel (now used in place of the original U. S. standard gage); American standard pipe threads (1942 revision); American standard hose connections for welding and cutting torches; tipping tools with high-speed steel and carbide tips; revisions in SAE steel; general applications of SAE steels with 270 typical uses; standard speeds for motor reducers as adopted by the National Electrical Manufacturers Association. It is worth while to mention that the companion book "Uses of Handbook Tables and Formulas" which is applicable to the 10th, 11th and 12th editions of Machinery's Handbook is available at the price of $1.00.

Practical Aspects of

Railroad Welding*

By Robert Moran†

Personnel and function of a railroad welding committee to meet requirements of all departments are suggested

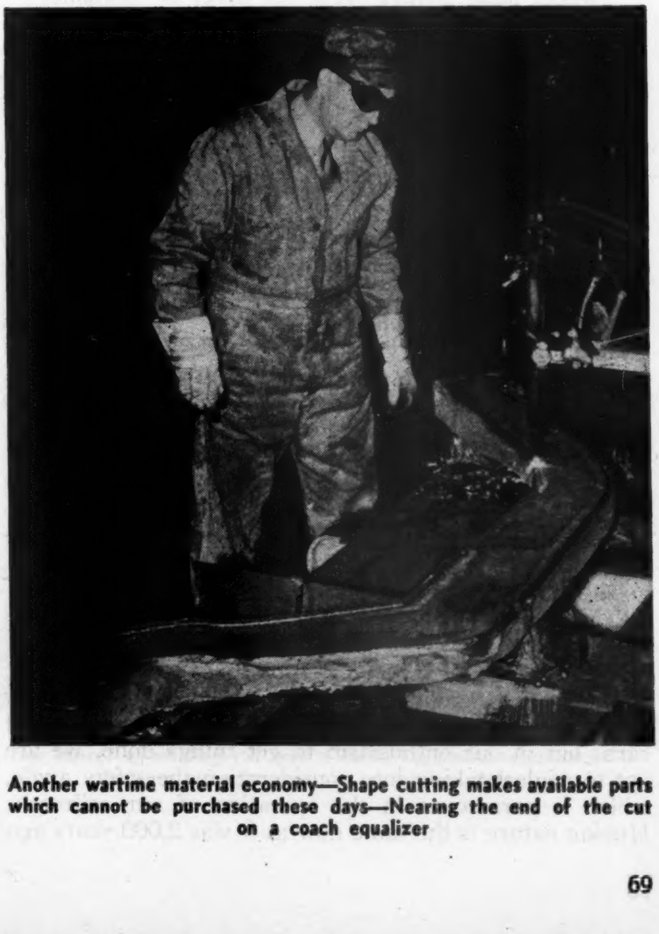
Costs and figures on the various welding operations being done by the railroads are not generally kept, but a fairly accurate check on cost is made at the introduction of practically all the major applications when adopted as a standard welding practice. On December 7, 1941, and up to the present minute the users of metal parts, whether it be castings, forgings, billets, round or square

Steps in repair of a worn ball joint—Right to left: (a) Worn ball joint turned down in preparation for welding—(b) After application of bronze by oxyacetylene welding—(c) The weld metal is then turned down to correct fit

iron, tank steel or firebox steel were asking the question, "What are we to do if we cannot get this material?" As we all know, the situation is not so bad that we are denied the material, but the uncertainty of when the delivery could be made was the chief concern. This resulted in countless meetings between manufacturers, purchasers and the user; calendars hanging on the office walls then came into practical use—time was the factor.

Because certain items for the repairs and maintenance of rolling stock could not be secured, standards were revised to meet the situation, with very careful consideration being given to the safety of operators and passengers in the change.

In the case of castings, fabricating was resorted to. Some of the outstanding or major items manufactured are locomotive cylinders, locomotive frame crossties, passenger- and baggage-car pedestals. Other items manufactured by the flame-cutting process are locomotive crossheads, valve crossheads, driving boxes, locomotive and passenger equalizers, etc. To increase further the service life of locomotive parts subjected to friction wear, consideration was given to hard-surfacing and the more modern method of flame hardening, with the thought of better performance and cheaper maintenance. To maintain locomotives, tenders, passenger- and baggage-cars, freight cars and gondolas properly and meet the specifications of classified repairs both the oxyacetylene and the electric arc methods of welding are being resorted to in a larger degree than ever before. Procedure control



Another wartime material economy—Shape cutting makes available parts which cannot be purchased these days—Nearing the end of the cut on a coach equalizer

* Abstract of a paper presented before the annual meeting of the American Welding Society held in Chicago, October 18-21, 1943. Parts of the paper not included in this abstract have to do with welding in the Maintenance of Way and Signal Departments.

† System welding supervisor, Missouri Pacific.

Welded piping provides trouble-free service on locomotives

and specifications have been strongly emphasized because materials commonly used have been diverted to other applications of greater strategic importance. Cost of reclamation or repairs is secondary.

When we speak of reclamation on railroads, our thoughts naturally turn to welding to fix or repair the worn or broken article. Reclamation and welding are closely allied. Not so long ago the first consideration we would give in determining the value of reclamation was the cost and the service life of the article to be reclaimed or reconditioned. The cost was determined by adding the scrap value of the article to the cost of the material, labor and shop overhead involved in repairs. If the margin of saving was small, or the cost approached the new price of a similar article, then the service life would have to compare favorably with a new article before it was entertained as a likely article for reclamation. Times have changed and we are forced to reclaim in some cases at a loss, first, as a necessity for maintaining our equipment due to the scarcity of steel and, second, as a patriotic effort.

This condition is going to involve deeper thinking on the part of those who are charged with the responsibility of getting the "go ahead" signal on items to be reclaimed. We have two regulatory bodies who define just how far we may go in the welding of parts on locomotives and cars; but in our enthusiasm to get things done, we are apt to neglect taking into consideration the safety angle, which is paramount in the operation of our railroads. Human nature is the same now as it was 2,000 years ago and let us not forget that we are constantly confronted with the human element, which is more or less the unknown factor in manual arc or oxyacetylene welding. Even though in some cases we are forced to use qualified operators on certain classes of work, a definite procedure of control should be employed to suit the particular job.

During the month of August, 1942, the rules pertaining to the welding of car parts were modified to permit a greater latitude of welding on such parts as cast-steel bolsters, yokes, couplers, etc. This was made possible after repeated tests had been conducted to determine the physical properties of welds under service conditions, and was a token of the farsightedness of this committee in foreseeing a possible shortage of these items, and the possibility that the metal necessary in the manufacture of these items would be diverted into articles necessary in the conduct of the war. There may be more modifications to permit still greater amounts of welding before victory has been achieved, so it behooves us all, especially those of us who have supervision and have welding under our jurisdiction, to live up to the rules, especially so in securing qualified welding operators to weld on such parts as were designated by the committee. This is truly a step in the right direction and will not only pay dividends to the railroads from a monetary standpoint but also from peace of mind.

Maintenance of equipment falls into the category of the mechanical department and has to do with the upkeep of locomotives, tenders, passenger equipment, freight equipment, Diesel equipment and work equipment which includes wreckers, clam shells, ditchers, spreaders, pile drivers, drag lines and tractor equipment of various kinds, and the maintenance of power plants at various points on the railroad generally is maintained or comes under the jurisdiction of the mechanical department.

How should welding be controlled on these various items so as not to conflict with the various rules and regulations as designated by the Bureau of Locomotive Inspection and the A. A. R.? Every railroad should have

Building up of a worn coach journal box with bronze welding rod restores another piece of equipment to help war transportation

an organization or a committee who could meet periodically to discuss welding practices and problems. They should be charged with the responsibility of not only suggesting and approving of welding practices but also be the medium through which the committee rules and standard practices be enforced. The welding committee should consist of one or two mechanical superintendents, mechanical engineer, engineer of tests, superintendent of car department or the master car builder, chief mechanical inspector, chief boiler inspector, the forging supervisor or general blacksmith foreman, and the chief welding supervisor.

A little goes a long way—Welding operator applying bronze to wearing surface of a flexible ball joint

Each is placed on the committee due to his particular knowledge as head of his department; for instance, if a suggestion were made at a committee meeting relative to welding some part of motion work, the chief mechanical inspector would approve or disapprove according to his interpretation and knowledge of the rules pertaining to welding on parts as defined by the Bureau of Locomotive Inspection. The same thing applies to boilers. The chief boiler insector is there to protect his class of work and will not approve of suggestions that conflict with rules and practices that are considered necessary for a safe and suitable method of repair. The engineer of tests has knowledge of metals and is invaluable in this respect; likewise the chief mechanical engineer will advise on design from the engineer's standpoint. The forging supervisor with his knowledge of the working qualities of the various steels used and their heat treatment is a great assets to a committee of this kind. He can advise on preheat and stress-relieving temperatures and can assist in formulating a procedure of welding.

With a committee of this kind you have a rich and abundant source of information and experience from which to draw at a committee meeting.

Welding practices on all railroads are pretty much the same in that similar items are welded or reclaimed by a method of procedure to suit conditions at the point at which work is being done. A welding practice should not be permitted until it has been handled by the welding committee and approved by the chief mechanical officer. The welding personnel in the shops should be encouraged to make suggestions to the end that welding will be done more safely, economically and practically.

The welding operator should undergo some type of welding test which would qualify him for the work in his particular department. The railroads of the middle west, to my knowledge, have a qualifications test similar to the approved A. W. S. test. These tests are not given with the thought of running men off the job but to make better welding operators. At the introduction of the qualifying of welders on the Missouri Pacific it was astounding to find that men we considered good old-time operators made the poorest grades and when the news got around the psychological effect it had was more astounding than ever. The older operators wanted to be looked upon as qualified welders and later on proved that they could qualify.

Tests were conducted semi-annually. This has been changed and eliminates a qualified welder from making further test coupons. He will make them only at the discretion of the shop superintendent, master mechanic or welding supervisor. This measure was put into effect to save precious materials and man-hours, not only on the part of the welding operator, but also of the men who prepare and finish the test coupons. It is expected that this practice will be canceled at the end of the war and revert back again to the semi-annual test.

The subject of how welding practices are originated and put into effect, together with the qualifying of the welders, has been touched upon. Materials, such as welding rods and electrodes, their size and grades and amounts, should have the approval of the party responsible for welding before the purchase order is made and approved, for the reason that he has a general knowledge of the welding programs in effect and programs planned months ahead. If this course is not taken, sizes and

A few ounces of welding rod save a costly equipment replacement—Building up worn seats in an injector body

grades are generally ordered that do not move fast. When this commodity is purchased in carload lots, the fast-moving size will be used, leaving the larger sizes still in stock, and when you cry to the high heavens for more $5/32$ or $3/16$ in., the WPB penalizes you and points out that "you have so many tons of welding wire on the last invoice date and your consumption is so many tons a month; therefore, we cannot approve of another request by you to purchase more welding wire." This is an item which should be policed, and if properly handled it will eliminate a lot of correspondence and help create a harmonious feeling between the users and those who have the authority to say whether you can or you cannot purchase it.

Moving Forgings From Furnace to Quenching Tank

By pre-setting the position of specially-designed lifting hooks such as those shown in the illustration accompanying this article and placing the quenching tank so that it is reached with but a small amount of straight-line travel, steel rings and other forgings are quenched in 25 sec. after the furnace doors are opened. The new handling method halves the time formerly required, and obtains better results from the heat treating process inasmuch as heat loss is negligible.

Special double hooks suspended from a crane of self-equalizing chains are held apart by operators with tongs on both sides of the car-type furnace when it is ready to be opened. The hooks are suspended at a

Special lifting hooks, the position of which can be changed, simplifies the job of handling forgings

height which will just allow them to clear the bottom of the ring when allowed to move in. With the hooks quickly positioned, the craneman lifts the ring just enough to clear the supports on which it was set, and moves it straight across and into the quenching tank, located only about 15 ft. from the side of the furnace. The quenching tank is lower than the furnace platform, further minimizing crane movement. This device was developed at the Schenectady Plant of the General Electric Company.

U. P. Supervisor Wins "Safety Ace" Award

Twice in 1943, a Union Pacific employee was selected as winner of the National Safety Council's "Safety Ace" award for outstanding safety achievements. The first was J. Glasmann, tank truck foreman at Denver, Col., who was honored on the Council's September 20 program.

The latest recipient of the award was M. C. Petersen, assistant enginehouse foreman at Green River, Wyo., who was given national recognition on the National Safety Council's Blue Network radio program "Men, Machines and Victory" on Monday, November 22. Mr. Petersen,

The drawbar pin-lifting device

in addition, received a $100 war bond from the National Safety Council as a part of its campaign to "Save Manpower for Warpower."

Mr. Petersen was recognized as an outstanding safety enthusiast who has conducted hundreds of safety meetings in his 22 years of employment with the Union Pacific. In addition he has developed and perfected two safety devices designed to eliminate hazards and save time and manpower. One is a device for grinding in steam-pipe joints on locomotives. The other is an air lift for removing and applying drawbar pins between locomotives and tenders on heavy power. The following description of these two tools is in Mr. Petersen's own words.

Drawbar Pin Lift

The drawbar pins of heavy modern locomotives weigh approximately 300 lb. This, coupled with the limited overhead space, make their application a hazardous operation. A machinist, W. B. Perkins, under my supervision at the Green River enginehouse, assisted me in developing this machine, removing all the hazards surrounding the job, as well as easing and expediting the operation.

We retrieved a standard 10-in. brake cylinder from the car department scrap car, removed the original piston

od and welded a length of steel tubing approximately 3½ in. inside diameter in its place. Inside this we placed another piston with leather cup and follower plate and at the upper end we made and welded to it a pocket designed to receive and hold the lower end of the drawbar pin. The inner piston and rod are doweled through the outer piston to prevent its moving beyond a predetermined distance and out of the cylinder. The original piston is ported through to the inner piston with a ¼-in. hole. The whole assembly, as shown in one of the illustrations, is mounted on four ordinary hand truck wheels of bolted and welded construction, thereby facilitating its movement from one locomotive to another and making it readily portable in the pits beneath the locomotive.

In use, the lift is lowered under the locomotive and drawn into position. The drawbar pin is placed on the side of the pit and two men readily slide it over the machine and place the lower end in place on the lift, leaving the pin in position as illustrated. A globe valve, placed in the air line to provide pressure regulation, is now slightly opened and the outer piston being larger in area moves up slowly, carrying the inner piston and pin with it, moving the pin about half-way into position. When the outer piston has reached the end of its stroke, the inner piston takes over and continues upward, pushing the drawbar pin completely into place. The pin is then held with a bar while the pressure in the machine is released by means of a ⅜-in. cut-out cock and the pistons drop to their lower positions. The drawbar keeper plate is moved into position under the pin and the operation is complete.

The possibility of injury either from difficulty in handling such an unwieldy weight in limited quarters, or of straining oneself due to lifting in cramped quarters, or the possibility of the pin slipping or falling during application, is completely eliminated.

Device for grinding steam-pipe joints on articulated locomotives

Steam-Pipe Joint Grinder

The steam-pipe joint grinder is really the brain child of one of our machinist helpers, Joe Vit, being developed with some assistance under my supervision. Some of the U. P. articulated locomotives have steam pipes to the No. 1 engines on which the top end of the back joint ring has a flat joint ground to the casting secured on the smokebox. Not having a suitable rig for handling this work we were holding these heavy joint rings by hand and grinding by hand which was somewhat dangerous and difficult and was attended by difficulty in securing a suitable joint due to the human element in attempting to hold the ring square. Using the differential of an old Model A Ford car, we remodeled the drive shaft with a splined sleeve and attached thereto a crosshead which would hold the steam-pipe joint ring in position by means of suitable set screws placed at an angle as shown in one of the illustrations. To the outside of the sleeve we applied a thrust ring and a lever toggle similar to the operating level of a Simplex injector starting valve. This, with suitable leverage provided by placing a piece of pipe over the forked lever, and the toggle straps having spaced holes, gave us a variable lift of from 3 to 9 in. and enabled one man easily to hold the joint ring in position.

We shaped the end of a portion of the original axle to receive the hex socket of an Ingersoll-Rand speed wrench. The entire assembly is placed on top of the main guidebar of the locomotive, slid into place and clamped under the joint. An abrasive compound is applied between the two surfaces which are being ground and, by using a reversible motor and alternately raising and lowering the joint by means of the lever, a first-class joint is quickly and easily obtained.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Rules Governing Welding on Boilers

Q.—We note on page 601 of the December, 1943, issue of the *Railway Mechanical Engineer* the statement that the Bureau of Locomotive Inspection, I. C. C. Rule No. 4 states that welding shall not be applied to any part of the barrel, dome, drum, or hip sheets of any boiler unless the stresses to which the parts are subjected are carried by other construction. Rule No. 4 of the laws, rules and instructions for inspection in testing of steam locomotives by the Interstate Commerce Commission covers the tensile strength of the material entering into the construction of locomotive boilers. It would be appreciated if you would advise on what page of the laws, rules and instructions for inspecting and testing the steam locomotive the rule you refer to is given.—A. G. T.

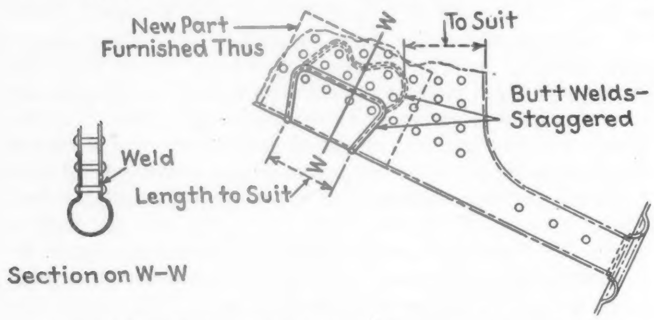
A.—The rule referred to is Rule 4, of the Proposed Rules and Instructions governing the Use of Fusion

Welding on Locomotives, Boilers, Tenders and Parts and Appurtenances Thereof, issued by the Bureau of Locomotive Inspection in 1937, as stated in the December, 1943, issue. These proposed rules have not been considered or approved by the Interstate Commerce Commission, and, therefore, they are not binding upon the carriers. However, they do serve as a guide when questions on welding arise.

Repairing Syphons

Q.—On one of our Mikados equipped with a syphon we found a bulge or blister on the under side of the syphon neck. What repairs, if any, should be made? Is it necessary to apply a patch or can the section be burned out and a new piece welded in place?—F. E. R.

A.—If the bulge or blister formed does not exceed 1 in. in depth it may usually be laid up hot with a hammer.



A welded patch can be used to repair the neck of a syphon

Greater damage should be repaired as shown. The patch should be rolled to the shape of the neck, the sides of the patch should be extended up between the first two rows of staybolts and the one side and between the second and third rows on the opposite side. The patch is then butt-welded in place.

Determining Neutral Axis

Q.—When bending steel plate of the thicknesses commonly used in boiler shells the neutral axis of the plate is generally taken as one-half the thickness of the plate under fabrication. I find, however, that plates one inch and over in thickness do not conform to this rule in actual practice. Is there any practical way of checking the actual neutral axis of plates over one inch?—M. E. R.

A.—The neutral axis of a plate can be obtained from the actual plate by using the following procedure. Take a test strip of the plate in question and plane one edge as smooth as possible. Without removing the test strip from the planer, moisten a piece of blue vitriol (copper sulphate) and rub the planed edge of the strip thoroughly from one end to the other keeping the piece of copper sulphate well moistened at all times. A thin deposit of metallic copper should cover the surface of the strip after the copper solution has become dry. Repeat the rubbing and drying operations until a fine even coating of copper has been obtained which entirely covers the planed edge of the test strip.

Remove the tool from the edge planer and in its place put a well-ground sharp-pointed tool stiff enough that it will not spring. With this tool scratch a fine line in the copper coating. Practice with the cross-feed screw of the planer until you know how far to turn the screw to advance the scriber tool 1/16 in. Scribe lines as exactly as possible 1/16 in. apart across the edge of the test piece. The lines may be 1/32 in. apart but they should not be farther than 1/16 in.

Next, bend the test strip giving one end a very long radius. Decrease the radius constantly until the other end of the test strip will fit the bending roll. The test piece is now ready for use. Cut from tin, or other thin sheet metal, a segment having the radius it is desired to work with in testing the neutral axis. Locate the desired radius on the test piece with this segment and make a chalk mark at that point or mark the test piece with steel figures which show the actual radius at that point. Next, with a small pair of draftsman's dividers or with a finely graduated steel scale, measure the distance between the lines in the copper surface at the required radius point. The lines may be found closer together on the outside of the bend and farther apart on the inside. Work patiently until two or three lines are found, probably near the middle of the strip width, which are neither wider nor narrower than the scribed lines before the test strip was bent. The neutral axis will be found between the mid-lines which have not been distorted. If there are but two lines the original distance apart the neutral axis will be between these two lines. If there are three undistorted lines the middle one will be the neutral axis of the test strip for the radius. By checking the test lines at other radii it may be determined if the radius of gyration, which is the distance from the neutral axis to one side of the test strip, is the same or different for varying radii.

Use of Unit Heaters In Enginehouse Heating

*By L. F. Wilson**

The article by Ford C. Pethick published in the Consulting Department, page 554, of the *Railway Mechanical Engineer* for November, 1943, conveys so many good and important suggestions in the matter of unit heater installations as to invite expansion of the subject and constructive criticism.

The advantages of unit heaters for enginehouse and shop heating systems are so generally appreciated as to make elaborate re-statement unnecessary. However, in the opinion of the writer, one marked advantage is destroyed in Mr. Pethick's recommendation for automatic thermostatic zone control. It is the exceptional enginehouse, the conditions of which are not best met by individual manual control, and this is because, even in the three unit zones which Mr. Pethick diagrams, there may be areas which do not require heat because no work is going on and, even in such zones, different classes of work and human beings of different minds require different degrees of temperature.

One of the greatest advantages in enginehouse heating by unit heaters lies in steam economy obtained by close limitation to the requirements, with elimination of heat in all dead sections, which in some enginehouses amounts to fifty per cent of the total floor area.

The difference in investment and maintenance cost between individual manual switches and automatic thermostatic installations is very considerable. The writer has made a comparison of cost of investment between that of an individual manually controlled complete enginehouse job recently finished involving twenty-two unit heaters, and that of automatic thermostatic controls. Had the automatic thermostatic controls been installed in this case, the difference in first cost alone

* President, Wilson Engineering Corp., Chicago.

ould have been $1,182.00, with expected maintenance arges not considered.

Another point of constructive criticism has to do with e horse-power of the unit heater motors and conse-ient volume in c. f. m. Enginehouses are notorious r atmospheric temperature stratification and for gase-s and vapor-air contamination. It is not possible to mbat these conditions satisfactorily in enginehouses, ith pits 100 ft. or more long, with less than 1½ hp. otors which in our installations accord an air volume r unit heater of better than 7,100 c. f. m. The effect to bring the already heated air of the upper strata own to the floor and build up a slight atmospheric essure against the large doors, which must be opened r the receipt and delivery of locomotives. Not only is, but the clearing of gases from welding operations, om firebox appurtenances, and from other sources, is ecessary for decent working conditions.

In cold latitudes this high c. f. m. capacity, carrying s B. t. u. at a lower final sensible temperature, serves defrost and dry up the vaporous air arising from ewly arrived locomotives covered with ice and snow. o use motors delivering low volumes, the necessary . t. u. is localized so greatly as to cause discomfort, hile at the same time not effecting the desired avoid-nce of stratification, and not clearing the atmosphere of ases and vapor.

This matter of using unit heaters with too small mo-rs, even where the required B. t. u. has been calculated, as been a common tendency on the part of railway en-ineering and mechanical officers, who are thus invari-bly dissatisfied with the results of such installations. here is very little difference in the cost of using the ½ p. motors recommended by Mr. Pethick, and the 1½ hp. otors with correspondingly larger fans recommended y the writer. The use of the larger motors is amply ustified by the economies so produced.

Much of the above is equally applicable to shop heat-ng systems. Unit heaters can be mounted as high as 5 ft., to clear craneways, to break up stratification, and o bring down to working levels the heated air of the pper strata, if the motors are of 1½ hp. capacity. In uch cases, the economy, due to recovery of B. t. u.'s therwise wasted, is very highly consequential, and the dditional amount of electric current required is by omparison inconsequential.

Here again, individual manual control for each unit eater is highly desirable, although the arrangement in-volved in one recent shop heating installation included a ingle heater on automatic thermostatic control. In peration, all manually controlled unit heaters are turned off at the end of the final working shift, and the auto-matically controlled heater then comes on at a lower emperature registration still sufficiently high to prevent reezing of piping. This means of safeguarding auto-matically takes responsibility from the watchman, who might desire unnecessarily higher temperatures, or who might possibly overlook the necessary protection against reezing. In large shops, of course, more than one unit heater under automatic thermostatic control might be justified, but only to meet the conditions described; and in shops operating full 24-hour 7-day weeks, no auto-matically controlled unit heaters would be required.

Perhaps, the installation of a sufficient number of units to allow for extremely localized heating effect would total a greater B. t. u. delivery than would be required if all of the floor area were to be heated to the desired temperature, but the advantages still predominate. For instance, there are practical reasons for placing a power-ful unit heater between each two stalls throughout the enginehouse, even though the total capacity of all would overheat. However, all calculations must be based on lowest outside temperatures to be encountered. There-fore, in marginal inter-seasons, the most carefully cal-culated total capacity would overheat anyway. By far the best and most economical operating plan is to make the number of unit heaters sufficient to provide one at each location for correct limited zone heating, and to avoid use of any of the unit heaters not currently re-quired.

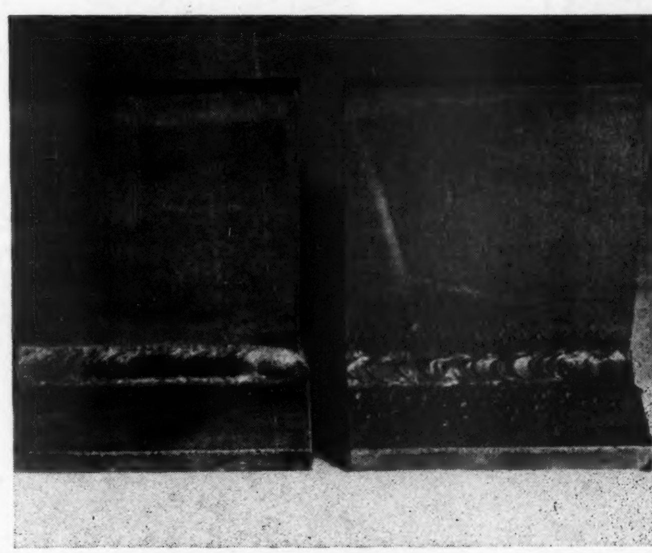
Questions and Answers On Welding Practices

(The material in this department is for the assistance of those who are interested in, or wish help on prob-lems relating to welding practices as applied to loco-motive and car maintenance. The department is open to any person who cares to submit problems for solution. All communications should bear the name and address of the writer, whose identity will not be disclosed when request is made to that effect.)

Spatter on Welded Parts

Q.—The quality of welds which we are obtaining seems sound enough but we are troubled with a spattered surface condition which tends to make the welds look poorly made. What are the causes of this condition?

A.—A tendency to spatter is an inherent property of some electrodes and the selection of a proper type is indicated where spatter is objectionable. The use of excessive welding current for the electrode in use can cause spatter and is readily overcome by proper ma-



Courtesy Westinghouse Electric & Mfg. Co.

Clean, unspattered surfaces as on the left can be obtained if care is exercised

chine adjustments. Holding too long an arc is often a cause and is met by training operators to use a proper arc length. Arc blow is another cause of spat-tering; when it is reduced the condition is eliminated.

There are a number of commercial coatings on the market which can be painted on the metal surfaces ad-jacent to the point of welding and which prevent spalls from welding to the surfaces of the parts. Painting parts with whitewash also serves the same purpose. When welding is completed the parts are then easily cleaned of what spalls have adhered to the coatings.

With the Car Foremen and Inspectors

A Revolving Air-Brake Work Bench*

In the modernized air-brake room of the Missouri Pacific at Kansas City, Mo., the most unusual improvement from a mechanical standpoint is the all-metal circular style work benches now used. They stand 4 ft. 3 in. high and cover an actual floor space of 1 sq. ft. The construction is faintly similar to that of a dentist's swinging-tray equipment stand. In other words, four movable tool-trays, pivoted on a center staff and adjustable as to height, will give the equivalent of 7 sq. ft. of bench space.

The base of each work bench is essentially a welded steel drum, 12 in. in diameter by 26 in. high with an 8-in. by 8-in. vertical sliding door in the front to permit using the inside of the drum as a receptacle for cleaning rags, tools, etc. The center staff is a 1⅜-in. round steel bar, 24 in. long, mounted vertically on top of the steel drum. The four trays are a close sliding fit on the center staff and they are positioned vertically as desired by spacing bushings of the required length, made of 1¾-in. O. D. steel tubing. It will be observed that one of these tool trays contains a fluid-cleaning pan welded in place. The tool trays are made of ¼-in. steel, 14 in. by 16 in. in size. Obviously they can be installed at any elevation or swung at any angle desired for most convenient handling of the work.

All-metal revolving air-brake work benches used at the Missouri Pacific shops, Kansas City, Mo.

The upper end of the center staff carries a vise clamp block, made of 2-in. square steel, 6 in. long. A 1⅜-in. hole is drilled near one end and a 1/16-in. slot cut through from the end to the hole, so that a ⅝-in. tap bolt can be used to draw the two halves of the circular bearing together and clamp the block in any desired position on the center staff. The other end of the vise clamp block is drilled with a 1 1/32-in. hole so that a bolted connection can be easily made to the triple valve body. Slightly different types of vise clamp blocks are required and can be readily made for handling K-1 and K-2 triple valves, or the service, or emergency portions of AB valves.

One important advantage of the new circular-type air-brake work bench is the reduction of fatigue strain from working in one position. Since the mechanic can move his work around a complete arc, thus taking advantage of the ideal position as regards light and changing his position as often as required, fatigue is minimized with favorable effects on the accuracy and volume of work turned out.

* From the October, 1943, Missouri Pacific Lines Magazine

ransferring Wheels rom Track to Track

ransferring a pair of wheels from one track to another a car repair yard is usually accomplished with great hysical effort when overhead or tractor cranes are not ailable. Workmen at the St. George, Staten Island,

mps, dollies and a transfer track expedite the removal and placing of mounted wheels on car repair tracks

. Y., shop of the Baltimore & Ohio have developed a ansfer device which is quickly assembled and expedites e handling of wheels removed from or being placed nder cars.

A track, long enough to span two adjacent repair acks, was built of 2-in. outside-diameter pipe jointed r easy handling and held together by welded cross-ieces. Two small dollies with flanged wheels are used support the pair of car wheels being transferred. A mp, 36 in. in length, which fits snugly on top of the eads of the rails, is used to roll wheels from the track p onto the dollies. The ramps are transferred to the djacent track and, after being pushed across the inter-ening space, the mounted wheels on the dollies are olled down the ramps to the desired position on the orking track. The pipe track is dismantled quickly by e removal of four holding pins and the ramps removed eady for use in another yard location.

This method of wheel handling is being made a stand-rd in repair yards of the Baltimore & Ohio.

Wheel Committee Report

. A. R. Mechanical Division circular No. D. V.-1047 is e report of the Committee on Wheels dealing with atters covered during 1942-1943. In it the Committee dicates its approval of having inspectors witness the estruction of rejected cast iron wheels as an alternative o observing the chipping off of the letter *R* from the AAR symbol on such wheels. The efforts of the Asso-iation of Manufacturers of Chilled Iron Wheels to de-elop an improved design having a 2 1/8 in. rim thickness s compared to the present standard 1 7/8 in. are men-ioned. Such wheels are to have the letter *H* cast on hem in line with, and two in. beyond, the serial number.

The Committee supported the use of the present out-f-round gage having the 3/64 in. projection as being con-sistent with the flat spot limit from the standpoint of out-of-roundness. Checks made on a number of roads and at one of the western gateways indicated that there has been a decrease in the number of wheels removed for worn-through-chill and out-of-round conditions since the revised gage was put into use.

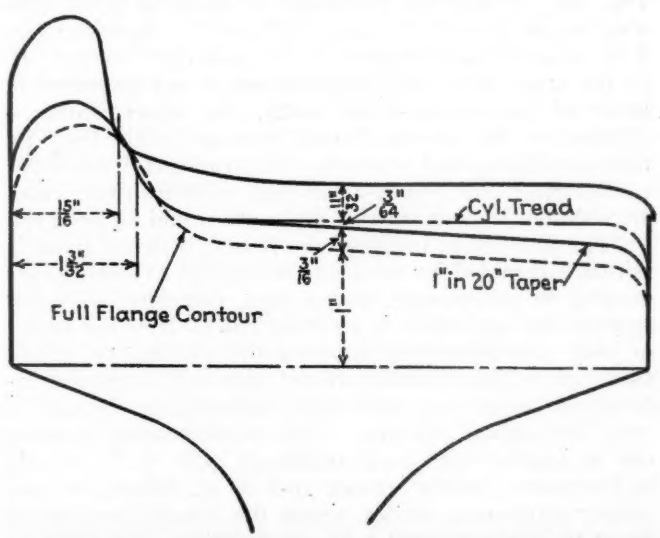
Data has been accumulated with respect to wheel de-fects causing derailments and wheels removed for major defects under both summer and winter conditions. The data has been studied and a detailed report submitted to the General Committee calling attention to the types of wheel defects responsible for derailments.

Comby Tread Troubles

Troubles were being reported with cast iron wheels having comby treads around the circumference, but not condemnable under the rules, which were alleged to be causing serious damage and delays to tank cars. A sub-committee was appointed to study the problem, it's report appears as Appendix A.

Service Guarantee for Wrought Steel Wheels

The Committee had referred to it by the Purchases and Stores Division a proposed new service guarantee for wrought-steel wheels. It did not subscribe to some of the conditions upon which the guarantee was based. Taking



Multiple-wear wheels can be so machined on their last turning that service life will be lengthened

into consideration the varying service conditions involved on different railroads it was of the opinion that the mat-ter of guarantee for wrought-steel wheel adjustments could best be worked out between the manufacturers and the individual roads. The proposed guarantee was not approved.

A sub-committee reported on an investigation made of the practice on the Atlantic Coast Line in building up worn flanges on wrought steel wheels. Authorization to carry on a test program on such wheels to determine the influence of thermal conditions developing from brake shoe friction was given. The tests being made had not reached a point where the ultimate results could be re-ported.

Restoring Contour of One-Wear Wrought Steel Wheels

After an investigation conducted by a sub-committee the recommendation was made that the reclamation of one-wear wrought steel wheels by turning to multiple-wear contour be permitted. A portion of the recom-

mendation was, "Also, that a note be incorporated following first paragraph of Rule 82 to read as follows:

"NOTE: The remount gage must not be used in connection with reclaimed one-wear wrought steel wheels marked 1-WT."

"REASON: When the one-wear wheel is turned to multiple wear contour and its value placed on service metal basis, it should be classified in the same category as a multiple-wear wheel insofar as the remount gage is concerned. The present remount gage is the basis for second-hand value of the one-wear wheel prior to reclamation."

This report appears as Appendix B to the circular.

Economy in Machining Multiple-Wear Steel Wheels for Last Service Period

The Committee, in stating that valuable savings in service metal could be effected at the time of the last turning of multiple-wear wheels by giving consideration to the relationship between flange and tread wear, said "An illustration of what can be accomplished along this line is shown in the figure. This figure represents actual conditions encountered in the restoration of the contour of a passenger service multiple-wear wrought steel wheel removed on account of thin flange.

"This wheel had a rim thickness of approximately $1\frac{9}{16}$ in. To machine the wheel to standard AAR contour would reduce the rim thickness to approximately 1 in. which would condemn it for passenger service. If, on the other hand, the flange thickness was sacrificed in favor of conserving tread metal, the wheel could be finished to the standard tread contour, with $1\frac{3}{32}$ in. thickness flange and retain $\frac{3}{16}$ in. tread metal above the condemning limit, or if machined to cylindrical tread, an additional $\frac{3}{64}$ in. in rim thickness would be retained.

"The practice of turning wheels to cylindrical tread is not recommended for wheels to be applied to foreign cars moving in interchange service and, therefore, does not require any alteration in existing rules. It is the belief of your Committee that applying this practice to wheels that can be placed under owned cars will be in the interest of conserving steel and, consequently, become a very economical practice. This recommended practice can be applied with good results to both 33 in. wheels in locomotive tender service and 36 in. wheels in passenger equipment service where the wheels have worn down to approximately 1 in. condemning limit prior to the last turning. It is the recommendation of the Committee that this be put in the form of an instructive circular and sent out to the Membership."

Wheel Shop Practices In Relation to Hot Boxes

Good sound wheel-shop methods profoundly affect the operation of all cars on all railroads. The path of least resistance presents the opportunity to criticize the other fellow's wheel, when it arrives in defective condition at your wheel shop. A constructive summary of work done at a wheel shop may foster ideas and invite criticism of methods, but the sum total will make for better shop practices, better finished wheels, and a decided influence for the best, in the always present hot box situation.

* Supplementary report of Special Committee on Lubrication, submitted for publication in the 1943 year book of the Car Department Officers' Association. The Chairman of this committee is G. C. O'Keefe, lubrication engineer, N. Y., N. H. & H., other members including D. J. Sheehan, superintendent of motive power, C. & E. I. and P. J. Hogan, supervisor of car inspection and maintenance, N. Y., N, H. & H.

When defective mounted wheels arrive at a wheel sh they should be checked for disposition. Cut journals a slid flat wheels should be segregated. Journals sho be cleaned, inspected, and if possible turned and put ba in service. Slid flat wheels should be inspected minut for cracks or brake burns. Other defective wheels shou be scrapped, and the good wheels set aside for remou ing. Axle centers, wheel seats, lengths and diameters journals, should be immediately determined, and tho failing to meet A. A. R. specifications be removed fr service.

When demounting wheels from axle, it should definitely determined that the axle is square in the m chine, because many an axle is bent during the operati of demounting. Axle should be placed on a ramp whe all grease and dirt is removed from the wheel seats a journals. The wheel seats and journals should then magnafluxed for seams and cracks; ultimately journ found with seams or cracks should be again magnaflux after they have been turned, to be doubly sure all sea or cracks have been removed. The radius of fillets a collars should be definitely determined as correct wh turned. Wheel seats should be turned, for many a rough and have grooves, caused by the wheels wh mounted and many wheel seats run out of true. T wheel collar should be turned to give clearance for whe when mounted, and the front part of the wheel seat shou be tapered about $\frac{1}{2}$ in. to allow the chamfer of whe bore to start correctly.

Before placing an axle in the journal-rolling machin the axle centers must be cleaned thoroughly. It is paramount importance, at this point, to clean all forei substances off journals and then apply clean oil. If t journal is not thoroughly cleaned, particles will becom embedded in the journal surface. If the rollers are out alignment the result will bear microscopic resemblan to a ploughed field, with hollows and high spots, a potential trouble lurking in the not too distant future f someone far from the wheel lathe. Rollers must be ke in perfect condition, and constantly checked.

Wheels

All cast and steel wheels are properly paired up, as t tape size and should be bored in up-to-date boring mill The table and chuck jaws are constantly checked and co centric with boring bar. The chuck and jaws should b oiled before starting each day's operation. After whee are placed in the chuck and jaws, they are checked o the back face of the flange and the top of the flange t determine that both are running true, before borin Boring tools must be ground in pairs of equal length; not of equal length, when the boring bar is withdraw the longer cutter will cut a spiral deep into the finishe bore of the wheel, which if mounted will ultimately caus oil seepage, although the pressure may be correct. Out side micrometers on the axle wheel seats show if the sea is taper or oval.

Wheels are bored, rough at first and then the ligh smooth cut for finishing, leaving no ridges, tears, o chatter marks in the bore. Use inside micrometers t make sure there is no taper to the bore. Always make chamfer or radius at the back end of the hub bore so tha it will position itself correctly when put on the axle whee seat, and will not score the axle seat or bore of the whee when mounting.

Mounting Wheels

When mounting wheels, recording and pressure gage should be constantly checked. The numbers and sizes o

heels must be entered opposite to recording pressures n the chart, and charts filed where they will be available.
Axles should be brought to the double-head press by a pecial truck and raised up by a hoist. A mixture of oiled linseed oil and white lead is applied evenly around he axle wheel seat. Wheels are then rolled up to the xle, having the bore of the wheel covered with lead mixure; the wheel is then raised level with the axle and arefully placed on the axle wheel seat being held in osition by the taper on the axle wheel seat and the hamfer in the bore of the wheel. The unit is then placed n the press and the wheel pressed on to the axle seat, uring which operation pressure indicators are constantly atched for correct pressures; wheels must be mounted entrally on the axle to A. A. R. standard gage.
The wheels must start evenly on the axle seat, otherise the seat and bore will be scored and the pressure ill rise suddenly. If such a wheel is allowed to go into ervice, oil seepage and a loose wheel may result.

Second-Hand Wheels

Good second-hand wheels should be segregated, diamters checked, and wheels of the same diameters paired p. Later, wheels should be rebored in a boring mill, aking sure the bore is concentric with the tread; if the ore is gouged out or scored and will not bore out, the heels are scrapped. Outside micrometers are used on xles and the same routine used as when pressing on new ast wheels and axles; both should be stencilled S. H.

On every wheel car that leaves the wheel shop with ew wheels, it is advisable to include about two or three air of second-hand wheels to replace wheels taken from oreign cars with slid flat or cut journal defects. If good econd-hand wheels are not always available, and the ecessity arises to replace with new wheels, a slid flat or ut journal, your company stands to lose $13, $14, $15 nd $17 on 8-in., 9-in., 10-in. and 11-in. wheels respecively. The frequency of such a replacement, multiplied y the number of points involved, gives a measure of the otal loss.

Wheels and axles, worn close to limit, should be stenilled and used on company cars only. When wheels are eceived at the wheel shop, journals are washed for inpection and measurements chalked on the axle. Wheels re checked for flange wear and measurements are placed n the inside plate of both wheels, giving the tire thickess, scrap limit, flange wear, and amount of tire to be urned off. The clerk and the machinist can by this ethod get all dimensions. The machinist must be impressed with the necessity of leaving a witness groove in he worn flanger, thus saving about ⅛-in. service material n each wheel which equals about 40,000 rail miles.

Passenger wheels when worn low can be turned and sed as 36/33, so marked on axle and wheels used under witchers. Before turning mounted steel wheels, mintely inspect and check the keys put in sleeves for variaion of thickness before placing sleeves on the journal nd into the machine. If the keys are not correct, the ar wheel will be turned out of round. Heavy cuts will ause wheels to become loose between centers or sleeves nd tightening up the machine before taking a finishing ut is good shop practice.

When turning cut journals or flange-worn wheels it is dvisable to turn journals first and wheels second; if wheels are turned first, they will run out of true. If xle journals are turned smooth, considerable time will be aved when rolling them.

Where passenger wheels are removed there should be kept on hand different sizes of journals with pulley seats turned. It will save time and expense if pulley seats are turned on axles before mounting the wheels. It is good practice to have 20 per cent of all axles mounted with new wheels, turned for pulleys and sent to points exchanging passenger wheels. Some axle centers run out of true ½ in. to ⅝ in. and cannot be turned true and leave correct dimensions to put pulley on.

Extreme care should be exercised in handling, blocking and shipping the mounted wheels to repair points. Nothing should touch the journals, and flanges of wheels cutting into axle centers are the forerunners of possible axle failures where deep cuts have been made in axles.

Some Hot Box Causes

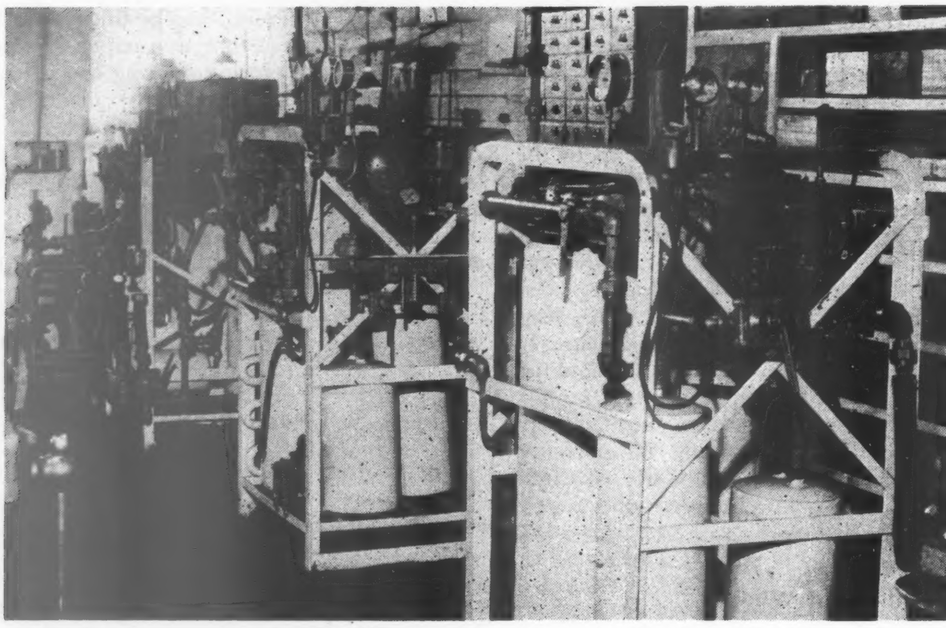
The subject, "Wheel Shop Practices and Its Relation to Hot Boxes," might be closed at this juncture; however, everything will go for naught unless repair points do their part. They must check the alignment of trucks and check the liners on the pedestals. Perhaps liners are alright on one side and worn out or missing on the other. The journal bearing lining may need to be broached. The wedge should be in good condition. Place journal boxes on without damaging the journal, and where boxes are a part of a unit, slide on easily without using force. The equalizers should be in good condition and fit squarely on top of the boxes.

Uneven wear of flanges indicates some condition which must be corrected. Wheels that are not bored true, mismating of wheels, wheel seats out of round, wheels pressed up against the collar of the wheel seat when pressed on, and wheels that are not turned true causing brakes to lock resulting in slid-flat wheels, are some of the effects of bad wheel shop practices which result in hot boxes.

This report is designed to emphasize the fact that those of us in wheel shops must fully comply with the Wheel and Axle Manual in the preparation, mounting and handling of wheels and axles.

* * *

Sectional plywood ceiling panels being applied in a box car



Erie Air-Brake Shop at Meadville, Pa.

Top: A battery of air-brake test racks—Left: Pistons are stored in a rack which is slotted to accommodate 74 pistons of various sizes—Lower left: Sand-blast unit for cleaning the inside of angle-cock caps—Lower right: Guillotine used in cutting worn air-brake hose—Standard splicing lengths of 6 in. and 16 in. are cut

Generators for Diesel Switchers*

By C. A. Atwell†

Characteristics required for self-excited machines which must function both as variable-voltage traction generators and as starting motors

The Diesel-electric locomotive power plant must be reliable and easily controlled under variable conditions of weather, location, motion, and frequently varying load. Mechanical and electrical simplicity and durability are very desirable features in order to obtain continued and reliable service with operators who are not always thoroughly acquainted with electrical equipment. Simplicity of the control scheme is also largely dependent on the generator performance characteristics and windings. This paper explains the electrical and mechanical features of some of the recent generators that have been developed for industrial switcher locomotives and railway switchers up to approximately 80 tons.

Mechanical Requirements

Generators with a single bearing at the commutator end have been adopted as standard for the sake of mechanical design simplicity. The armature is supported at the engine end by the engine crankshaft. This arrangement uses the smallest number of parts and provides for the closest coupling between the generator and engine.

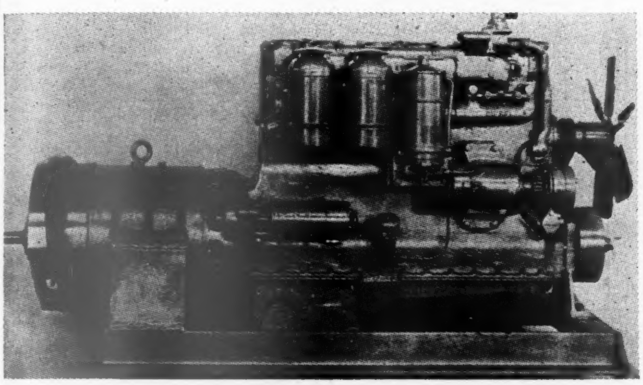


Fig. 1—Engine-generator unit arranged for three-point support (1,800 r. p. m.—140 hp. net input)

Steel disk couplings, flexible to angular misalignment, are employed on the higher speed engine-generator combinations where the generator stator is bolted solidly to an engine bell housing. The coupling flexibility takes care of slight inaccuracies in machining that may prevent the engine shaft and the generator shaft from being exactly in line. The steel disk coupling does not have rotational flexibility. This is not desirable as the generator armature should act as a flywheel for the engine, thus allowing the engine flywheel to be cut down in weight merely to what is necessary for coupling purposes. When the generator stator is rigidly connected to the engine by being bolted to a bell housing, the whole power plant is mounted with a three-point support, see Fig. 1. Two of these support points are at the sides of the generator frame and the third point at the opposite end of the engine. This three-point support makes it easy to provide a flexible mounting for the complete power plant by having resilient supports at these three mounting points.

Another common method of combining the engine and generator into a unit power plant is that of supporting both on a rigid bedplate, see Fig. 2. The generator shaft and the engine crankshaft are aligned accurately before the generator frame feet are bolted solidly to the bedplate and doweled in position.

How large should a generator be to operate with a given engine? One engineer expressed it by saying that the generator should be able to do anything that the engine will do. This is a rough but simple way of stating it and is a very general guide. The Diesel engine and the d. c. generator are such different types of power machines, however, that there is more to it than such a simple statement. More specifically, the generator size is determined largely by the torque and speed that the engine can supply to it continuously and by the maximum volts and maximum amperes demanded of the generator by the electric driving motors to meet the required locomotive performance. The most economical generator size is obtained when both it and the driving motors are designed at the same time with proper regard to voltage and current values.

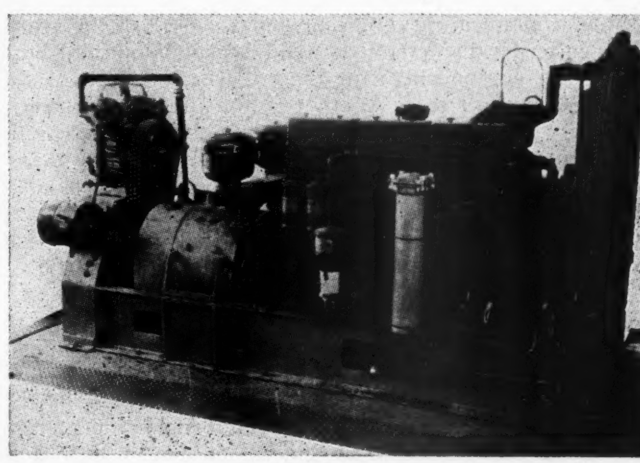


Fig. 2—A locomotive power unit arrangement that affords easy access and good ventilation for both generator and engine (1,000 r. p. m.—295 hp. net input)

Naturally, generators direct connected to high-speed engines are smaller than those for slow-speed engines. Usually, engines for locomotive service with operating speeds below 1,500 r. p. m. are called slow speed, and those above 1,500 high speed.

Generator design permits a choice of the ratio of

* Abstract of a paper presented at the annual meeting of the American Institute of Electrical Engineers, New York, January 25, 1944.

† Design engineer, transportation engineering department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

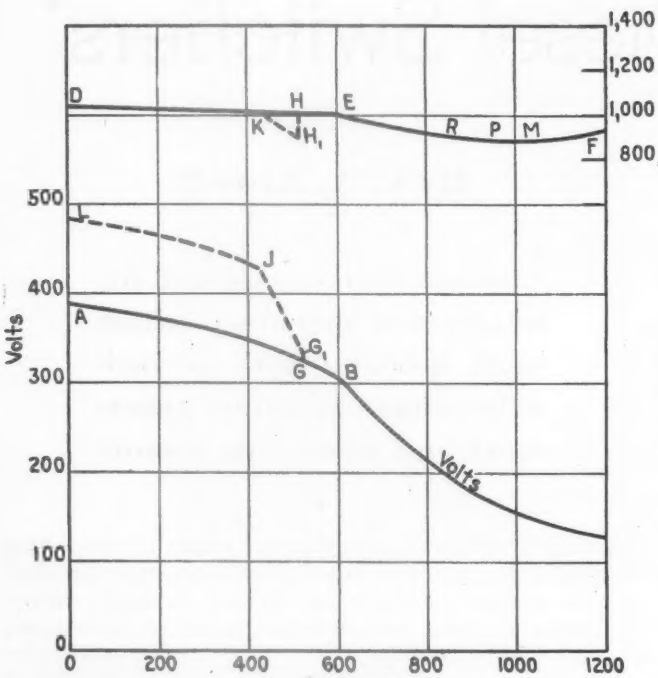


Fig. 3—Typical generator voltage and speed-regulation curves

diameter to length. The result is always a compromise between the "short and fat" and the "long and skinny" types. This compromise is the result of consideration of the economical ratio of diameter to length of the armature core, the diameter that will best suit mounting with the given engine and a minimum overall length of the engine-generator set. Another factor affecting this ratio is the critical speed of the rotating members of the engine and generator taken together. In some cases, the diameter of the generator armature has been made smaller than would otherwise be required to reduce the armature WR^2 and keep away from critical speed vibrations that might cause dangerous stresses in the rotating parts.

This type of generator is well suited to effective self-ventilation by a fan on the armature shaft. The generator is nearly always mounted in a protected compartment so it is not necessary to enclose the space around the commutator other than to supply a cover over the top to protect the commutator and brushholders from falling objects. The arrangement shown in Fig. 2 is especially effective in assuring clean air for cooling the generator and using the air exhausted from it to assist in ventilating the engine compartment. A vertical partition in the enclosing hood (not shown in the photograph) is located at the center of the generator body and prevents hot air from the engine compartment being used to ventilate the generator. In this case, the blower for force-ventilating the traction motor and control, the air compressor and the auxiliary generator are all conveniently arranged to be driven from a shaft extension at the commutator end without in any way preventing easy access to the brushholders and commutator.

Electrically, the generator must act as a generator for supplying power to the motors and also as a battery-driven motor for cranking the engine. These two types of electrical performance will be considered under separate headings.

Performance Characteristics As a Generator

A Diesel-electric locomotive generator is supplied with a rather definitely limited amount of power input. Unlike the ordinary power house lighting generator, the voltage cannot be kept constant over a wide range of ampere load. This is because an increase in current without a corresponding decrease in voltage means an increase in power beyond the ability of the engine. The ideal generator regulation characteristic is one that supplies just the right voltage at any ampere load and speed so that its output plus the losses will exactly balance the power supplied to the generator. In other words, the problem of the generator regulation is to make its power input balance the output of the engine at any ampere load demanded by the traction motors and at any speed and throttle opening of the engine.

Many types of separate exciters and field current regulators have been considered for properly adjusting the generator field strength at different ampere loads so that just the right voltage is obtained. Many of these schemes are too complicated or introduce factors of unreliability or additional cost of maintenance to have found favor for use on small and medium size switcher locomotives.

The type of generator that gives a close approximation of the ideal regulation and at the same time an ultimate in simplicity is a modification of the ordinary self-excited d. c. generator. The modifications consist of adding a small percentage of separate excitation from the locomotive battery and a special unsymmetrical shaping of the main pole faces. The unsymmetrical main pole shaping is allowable because the rotation is always in

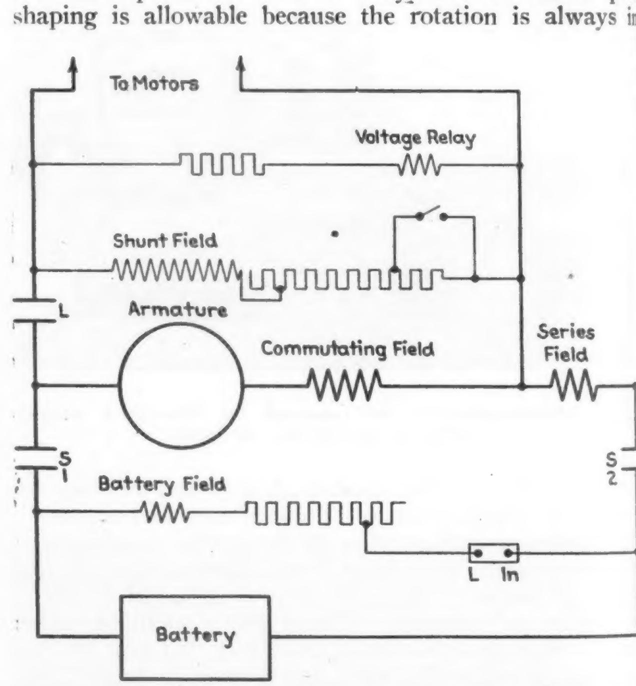


Fig. 4—Schematic control diagram showing simplicity of circuits

the same direction. The object of this pole face shaping is to change the load saturation curves with respect to the no-load saturation curve so that the field excitation provided by the self-exciter and battery fields will closely approach the ideal voltage regulation. This effect results from a compounding action that counteracts the effect of armature reaction to the desired degree.

Fig. 3 shows test voltage and speed regulations of a generator driven by a Diesel engine delivering 275 net hp. to the generator at 1,200 r. p. m. From F to E on the speed curve, or C to B on the voltage curve, the generator is absorbing full throttle power from the engine. Over this part of the curve, the engine speed is determined by the load the generator demands from it. Since the speed is approximately constant, the horsepower input is also approximately constant.

At E the engine governor starts to operate and the speed from E to D is determined by the governor and not the generator load. The part of the voltage curve BA is the voltage that the generator will produce at this governed speed with the same field setting as for the full throttle operation from C to B. Point B is called the unloading point. Most of the operation of a switcher locomotive will be over the voltage range from C to B; and when maximum power and speed are required over this range, the operator will use wide-open throttle. Actually, in switching service or even in so-called transfer service, full throttle is not used for a very long period of time. At partial throttle positions, both speed and voltage are lower at any given current value. Since amperes represent locomotive tractive force, partial throttle and lower voltage simply mean lower speed at a given tractive force.

In cases where the locomotive is required to do high-speed service at light tractive forces, it is desirable to provide a second field setting so that a higher voltage unloading point will be obtained, as at J. This is obtained by decreasing the amount of resistance in the self-excited field circuit when the voltage has increased to G. This change is conveniently made with a voltage relay. This permits full throttle loading with speed H_1—K and voltage G_1—J. At K, the engine governor begins to operate and at lower ampere loads, the speed is determined by the governor and the generator produces voltage J—L.

It is obvious that if full power were taken from the engine at very low current values, the voltage required would be very high. The minimum current for which the unloading point is set must be chosen with due respect to the maximum voltage that the generator commutator is good for and the voltage required by the traction motors to produce the specified high-speed performance of the locomotive.

It should be kept in mind that the performance shown in Fig. 3 is the *maximum* performance of the power plant and that most of the operation will be at less power and correspondingly lower speed and volts. This lower power performance will be a result of the operator not using full throttle. Diesel engines for locomotive service are not intended for full throttle operation continuously. The generator could operate continuously between two limits of continuous rating. The upper limit of continuous ampere rating is determined by the heating of the main current carrying parts such as armature windings, commutating field windings, and commutator; and the minimum limit, by heating of the self-excited field which has increased amperes and resulting increased heating as voltage rises.

The battery field uses only a few amperes from the battery and is left on at all loads. The purpose of the separately excited battery field is to supply a positive flux in the magnetic circuit and definite voltages at the lower operating speeds. The special shaping of the main pole faces is of assistance to the battery field in this respect.

Performance Characteristics As a Starting Motor

The most convenient method of engine cranking is to use the generator as a starting motor. This eliminates the necessity for a separate starting motor with its mounting and gearing to the engine flywheel.

A series motor characteristic is necessary to supply both high breakaway torque and the necessary firing speed and torque. A separate series main field winding is built into the generator especially for this purpose. At starting, this field winding is connected in series with the armature and commutating field. This starting motor circuit is connected directly to the battery terminals until the engine fires.

Engine builders are usually in a position to furnish information on the breakaway torque required to start the engine from zero speed and the speed and torque required at firing. The best method of obtaining this information with all mechanically driven auxiliaries connected as in service is by means of an oscillographic test recording volts, amperes and speed of the generator acting as a starting motor. The values of speed, torque, current and volts during starting are such rapid transients that ordinary meter readings are very uncertain.

Fig. 5 is a tracing of a typical oscillogram of such an engine starting test. A 60-cycle timing wave was included in addition to the values of volts, speed and amperes. In this case, speed was recorded by a disk mounted on the engine shaft that made eight contacts per revolution. The speed at any point along the curve can be obtained by finding the number of cycles of the timing wave corresponding to a certain number of the speed indicating impulses. For example, at the firing point, four speed indications or one-half revolution correspond to 8.4 divisions on the 60 cycle timing wave, or 214 r. p. m.

In this oscillogram the current record is used to measure instantaneous torque. The actual torque is obtained by referring to an ampere-torque curve previously obtained from a factory test of the generator as a series motor. The initial inrush of current is not a measure of breakaway torque since this current is limited only by the impedance of the circuit and would represent more torque than required to start the engine turning. The ripples in the current curve indicate variations of torque due to the cylinder compressions. The maximum value

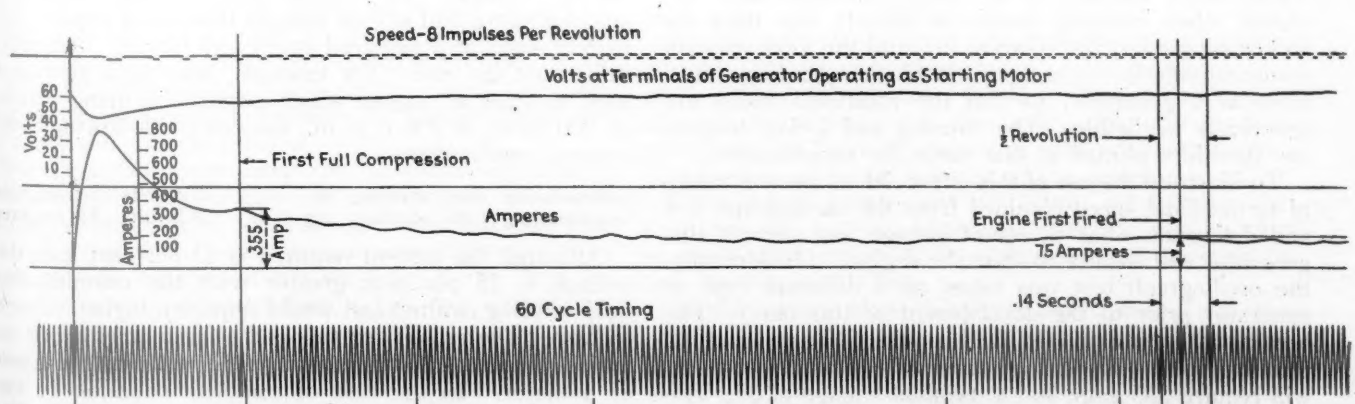


Fig. 5—Typical oscillogram of test to determine engine starting requirements

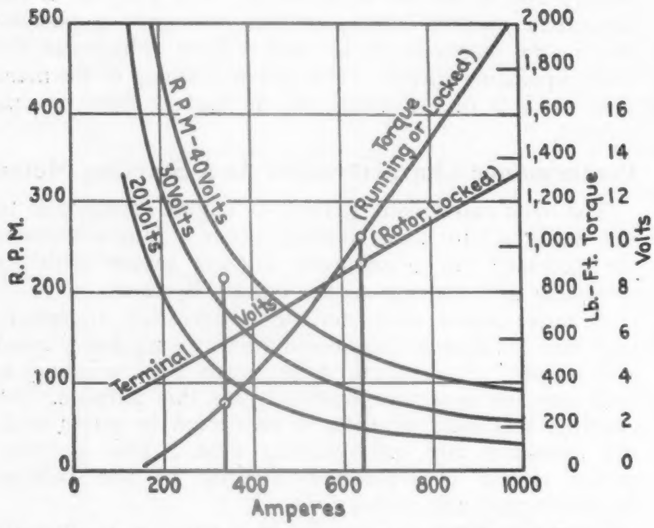


Fig. 6—Typical curve of generator operating as a series starting motor

of the first full compression has been taken as the current corresponding to maximum breakaway torque. This value scaled from the oscillograph is 355 amp. From the ampere-torque curve for the generator used in this test, this current corresponds to a torque of 1,040 lb.-ft.

After breakaway, acceleration continued up to a time of approximately 2.0 seconds after which the speed was nearly constant as indicated by the equal spacing of the speed indicator impulses.

When the engine fired, a sudden decrease in current took place. The point is accurately determined by drawing a tangent to the tops of the ripples of the current curve just ahead of this decrease. The engine firing in this case started at 3.18 seconds after 9.15 revolutions, at a speed of 214 r. p. m. at 315 lb.-ft. torque. A number of such tests should be taken under varied conditions of temperature, engine oil viscosity, and length of time the engine has been standing. This information is necessary to provide data for designing the series field winding of a new generator and to determine the characteristics of the battery that will be required to insure engine starting under these conditions.

Fig. 6 is a typical curve of a generator operating as a series starting motor, obtained from factory test under steady-state conditions. The curve is plotted as shown so that either breakaway or firing torque can be read from it and also the voltages required. The torque curve was determined by reading pounds at the end of an arm clamped to the shaft under locked condition. This was checked by calculating torque from inputs, speeds, and losses while running at 30 volts. Theoretically, the torque when running should be slightly less than the locked torque but the speed is low and the field strength comparatively low in comparison to the operating conditions as a generator, so that the rotational losses are practically negligible. The running and locked torques are therefore plotted as one curve for simplification.

To illustrate the use of this curve, let us use the values of torques and speed obtained from the oscillograph test and determine what values of voltage and current this generator will require to start the engine. (Incidentally, the oscillograph test was taken on a different type of generator prior to the development of this one.) The breakaway torque of 1,040 will require 640 amp. and 9.2 terminal volts. The firing torque of 315 at 214 r. p. m. will require 335 amp. and a terminal voltage of 35. The latter value is obtained by interpolating between the 30- and 40-volt speed curves.

Fig. 7 shows these volt-ampere points located on the same plot with the voltage of a proposed battery. The battery voltage curves were obtained from the battery manufacturer's data. Such data is usually given in volts per cell and amperes per positive plate. It is plotted here as total amperes and terminal volts for the battery considered. The volts drop from battery to generator terminals must be accounted for. This drop includes that of such switches and contactors as are in the starting circuit. It is advisable to utilize liberal cable size in this circuit and to keep the lengths as short as possible because a few volts drop multiplied by the amperes required, represents a large percentage of the power being drawn from the battery.

If the volt-ampere points for breakaway and firing lie well below the generator terminal voltage curve, then the battery proposed can be considered as adequate.

The question is sometimes asked as to why the commutating field winding is not omitted when the generator is used as a starting motor at the comparatively low

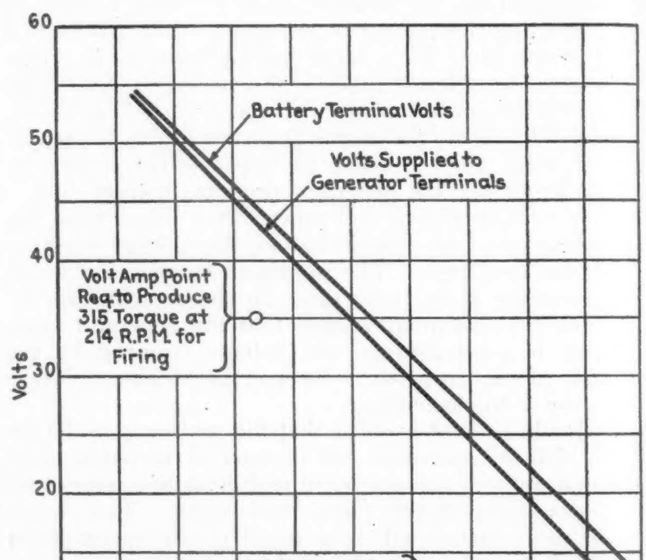


Fig. 7—Battery volt-ampere curve with volt-ampere points for a given engine's starting requirements

battery voltage. This would give a lower resistance starting motor and at first thought this would require less battery volts at a required speed and torque. Actually, this is not the case. For example, tests on a generator used to start an engine which required a firing torque of 200 lb.-ft. at 200 r. p. m., showed the following volt-ampere requirements:

Commutating field winding, in	27.5 volts	375 amperes
Commutating field winding, out	34.5 volts	325 amperes

Although the current required is 13 per cent less, the voltage is 25 per cent greater with the commutating field winding omitted and would require a higher voltage battery. The reason for this is the familiar effect of an under-compensated commutating field reducing the speed of a motor. In the case of complete omission of the commutating field coils with the poles still in place, the under-compensating effect is very marked and produces

the unfavorable change in required volts and amperes shown.

Conclusion

Generators having the mechanical features and the electrical performance described in this article are being applied to many sizes of industrial and railway switching locomotives at the present time. In addition to use on railroads and in industrial plants, many are being used by the Army and Navy in this country and overseas. Others are being supplied to our Allies. Their simplicity and reliability will be important factors in prompt movement of supplies and men in the many locations where they will be used.

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Coal-Burning Power Plant on Wheels

The war is responsible for the design of a complete 5,000-kw. central station, completely assembled to make a railroad train of eight cars. The power train is suitable for use in almost any part of the world. It has been designed to use coal of unusually low quality. It is suitable for arid or devastated regions where water may be so scarce it would have to be delivered in tank cars. It will work where temperatures range from 110 deg. F. above to 40 deg. F. below zero. According to engineers of Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., this rolling power plant can be hauled by a locomotive to any spot where there are railways tracks and in about 48 hours can be made ready to deliver power.

In wartime such power trains can follow victorious armies into recaptured areas to rehabilitate local industry. Conversely, they can be removed from areas about to fall into the hands of an advancing enemy. In peacetime the trains can furnish power for flooded plants and for other similar emergencies.

The first two cars carry the air-cooled condensers while the third car carries the turbine generator with switchgear equipment. Number four and five cars take care of auxiliary equipment and water storage. The water storage supply will run the train, under most severe conditions, for more than a full day without replenishment. Number six and seven cars are for the boilers while car number eight provides space for quarters for the crew and storage for lubricating oils, spare parts, etc.

The two boilers produce steam at 600 lb. gauge, 750 deg. F. from available coals. Even lignite, having a heat content of only 7,000 B. t. u. per lb. will work satisfactorily. Boilers are of water-tube, double-drum construction, have both forced and induced draft fans and have air-operated locomotive-type stokers. The single turbine-generator unit delivers to the bus 6,250 kva. at 80 per cent power factor, 6,300 volts. Power is delivered to a six-cubicle, metal-clad switchgear for distribution. Because intake ventilating air may be dusty or dirty, the generator is provided with a self-cleaning air filter. A Diesel-driven generator supplies 75 kw. capacity for plant and auxiliary purposes.

In many places where such a rolling power unit is needed, cooling or boiler water may be virtually non-existent or may be of poor quality. To meet this condition the condenser is air-cooled and the condensed steam is reused. Four motor-driven propeller fans draw air over eight coolers in each of the condenser cars. Even with cooling air at 95 deg. F., the condensers are able to condense the full amount of steam; the condenser water is then pumped back to the feed-water tank car. By this method it is expected that less than three per cent make-up water will be required. All make-up water is filtered, softened, and evaporated in the auxiliary car.

Placing a 5,000-kw. plant into a train of eight cars presented scores of engineering problems. The trucks were designed specially rigid so that no torsional movement of the frame in transit can rupture pipe connections. All apparatus, meters, shafts, gauges, etc., are braced so as not to be injured by a sudden stop of the train. Pipe and electrical circuits between cars are disconnected while the train is en route. This necessitates having some means of aligning the cars preparatory to going into service. Because of the tight fit in the turbine-generator car, the sides are removable to give access to the generating unit should dismantling be necessary. Therefore, supports for a crane, overhead piping and conduit are all built up independently from the floor. Many problems of unequal expansion had to be solved since the train must operate in climates where the temperature varies over a wide range.

Inside Enginehouse Feeders*

It was formerly the practice of the Illinois Central to install power feeders for enginehouses on the outer circle wall, using weatherproof cable on insulators or secondary racks attached to the outside of the wall. A tap was made for each stall and brought in through the wall, using a service head, a fuse cutout and a conduit at each stall.

To conserve both labor and material these feeders are now run on secondary racks or insulators on the inside of the roundhouse, thereby saving considerable labor and material, and also eliminating the trouble experienced in northern territory with icicles that form on the eaves and drip directly on the cables.

The wiring system now employed for lighting the enginehouses makes extensive use of non-metallic sheathed cable—often of the rubberless type—saving rubber, conduit and fittings.

In the wiring of yard offices, small shops, etc., the railroad is now employing type EI wire on insulators or knob and tube and also EI non-metallic sheathed cable, and making extensive use of all-porcelain outlet boxes, switch boxes and covers.

* Abstract from the December, 1943, Annual Report of the Electrical Section, Engineering Division, Association of American Railroads.

View of the yard from the No. 1 retarder and switch control tower

Loud Speakers in a Hump Yard

Illinois Central uses speakers in its Markham classification yard for giving instructions to skate men and engine crews

IMPROVED operation and reduction of damage to lading have been effected in the northbound Markham, Ill., hump classification yard of the Illinois Central by the installation of loud speakers mounted on poles near the mid-point of the yard. Either the office at the hump or the yardmaster's office at the lower end of the classification yard may issue instructions over the speakers to the skate men or to the engine crews who move cars from the classification to the departure yard.

Markham Yard, extending between Harvey, Ill., and Homewood, a distance of three and one-half miles, is the main terminal yard of the Illinois Central System in its Chicago territory. It contains about 22 miles of track with a capacity of 2,300 cars. It is located 20 miles south of the railroad's South Water street freight-house terminal in Chicago and is the northern terminus of road freight trains. The yard consists of two major units, one for northbound and the other for southbound traffic. Each unit consists of a receiving yard, a hump classification yard, and a departure yard.

The northbound yard in which the speakers are used has a receiving yard of 15 tracks from 90 to 110 cars capacity each, a supplemental yard adjacent to it called a rehump yard with four tracks of 40 cars capacity; a hump classification yard of 62 tracks each with 20 to 60 cars capacity, and a departure yard of 10 tracks each having a capacity of 80 cars. Electro-pneumatic switches and car retarders, controlled from five towers, switch cars leaving the hump into any one of the 62 tracks and control their speed.

Four skate men are employed who place skates to stop the first few cars which enter the tracks, to further retard any car which is arriving at too great a speed, and to separate entirely any car containing fragile lading, the coupling being done later by the engine crew. To enable the skate men to perform this work effectively, it is frequently necessary to notify them of special conditions at the time the car in question goes over the hump. The loud speakers have satisfied this requirement.

A further improvement in operation is obtained by the fact that the yardmaster as well as the hump operator may use the speakers. He may advise the engine crews when cuts of classified cars are ready for transfer to the departure yard and also issue instructions concerning special conditions. Messengers or the yardmaster himself are otherwise required to deliver orders to engine crews and the speakers allow the classification yard to be cleared more quickly than would otherwise be possible. The speech reproduced by the speakers is remarkably clear and the volume is such that the voice may be clearly understood at a distance of 1,500 ft. against a 20-mile wind.

Major facilities in the yard include the following:

Plate fulcrum scales with automatic recording devices located at the hump.

Car retarders and remotely controlled switches.

Illumination from batteries of floodlights on high towers.

Pneumatic tubes for handling waybills to and from the general yard office.

Teletype machines for writing switch lists in the various switch towers and hump and yardmaster's office.

Microphones and loud speakers for communication between the yardmaster's office and towermen in the classification yard.

Color-light signals for controlling the movement of pusher engines while humping.

Terminal for housing, servicing and repairing locomotives.

Car repair yard.

Automatic telephones.

There are telephones in booths at various places in the yards by means of which men in the yard may hold two-way communication with either the hump or the yard office, but these do not allow for sufficiently rapid contact to accomplish the purpose of the loud speakers.

The Loud Speaker System

The yard and hump offices are each furnished with one telephone type handset having a built-in, push-to-talk switch. Four conductors (2 pairs) in a telephone cable connect each handset with control and amplifier equipment located near the mid-point of the classification yard. Parkway cables are used to connect the amplifiers to four speakers on poles in the yard. The speaker mechanisms are 15-watt (nominal) units in 45-deg. baffles, mounted two on a pole with each pole pair driven from one 50-watt amplifier. The equipment is designed to provide immediate availability for use 24 hours a day.

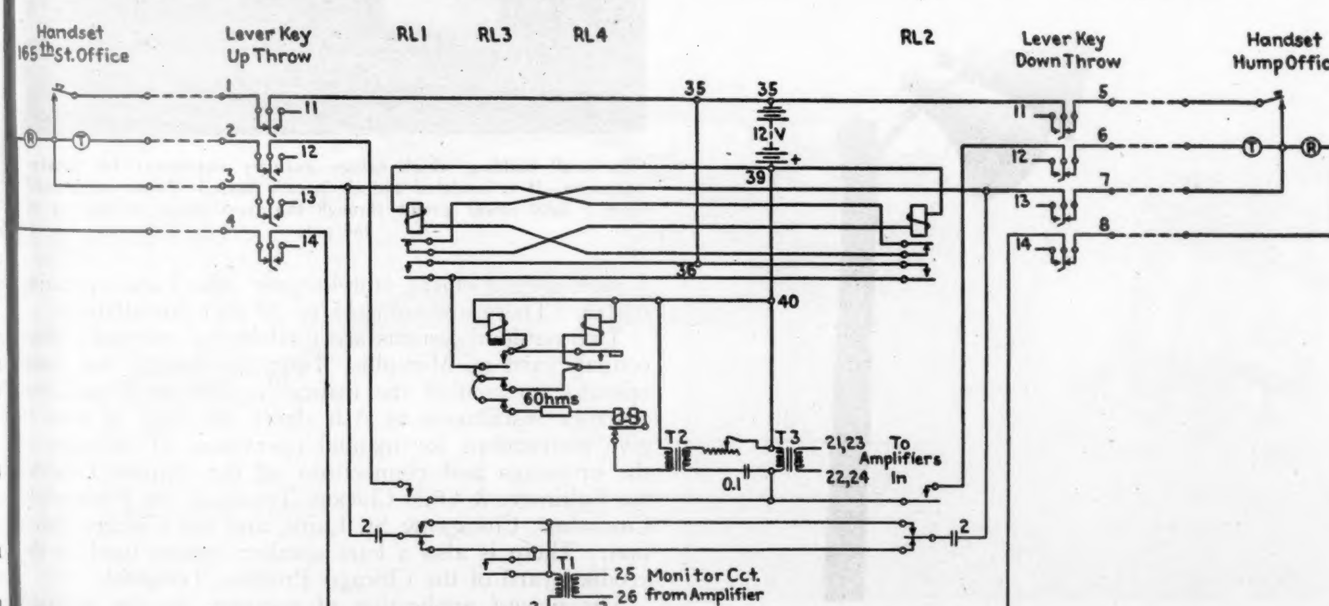
To make use of the system the handset is placed to the head, as in normal telephone practice. If speech is heard in the receiver the other handset is in use. Pressing the push-to-talk switch will connect the handset transmitter for use, if the other handset is idle. A tone signal will then be heard in the receiver and will also be broadcast in the yard as an "attention" signal after which the message may be broadcast. The message is spoken slowly and distinctly and after a brief pause is repeated. Failure to receive the tone signal indicates that the control equipment has not prepared the transmitter circuit for use.

Referring to the drawing, assume that the handset in the office at One Hundred Sixty-Fifth street is to be used. Operation of the push-to-talk switch closes a circuit from negative battery through interlock contacts on relay RL 2 and the coil of relay RL 1 to positive

Interior of the equipment building showing control assembly and amplifiers

through the transmitter and the primary winding of transformer T 3 to positive.

In addition, RL 1 completes a circuit from negative through contacts on RL 3, through a 6-ohm resistor, through a small high-frequency buzzer and the primary of transformer T 2 to positive. RL 4 operates its arma-



Schematic circuit plan of speech and control circuits

battery. RL 1 operates, completing a circuit from negative through contacts on RL 3 and the coil of RL 4 to positive. RL 1 also completes a circuit from negative

ture spring which starts vibrations in its weighted spring and gives intermittent contact to complete the coil circuit of RL 3, a slow operating relay. When the vibrations

of RL 4 springs have about stopped, (approximately 1½ seconds) RL 3 operates. Operation of RL 3 locks itself in through RL 1 contacts, releases RL 4 and opens the buzzer circuit.

The buzzer tone is carried from T 2 secondary through an adjustable resistance, (tone volume control) and a condenser to T 3 primary and from T 3 secondary to

T. J. Reid, superintendent freight service, Illinois Central, demonstrates use of handset in the hump office

the input of the amplifiers. Transformer T 3 is also the coupling (repeating coil) between the handset transmitter circuit and the amplifiers.

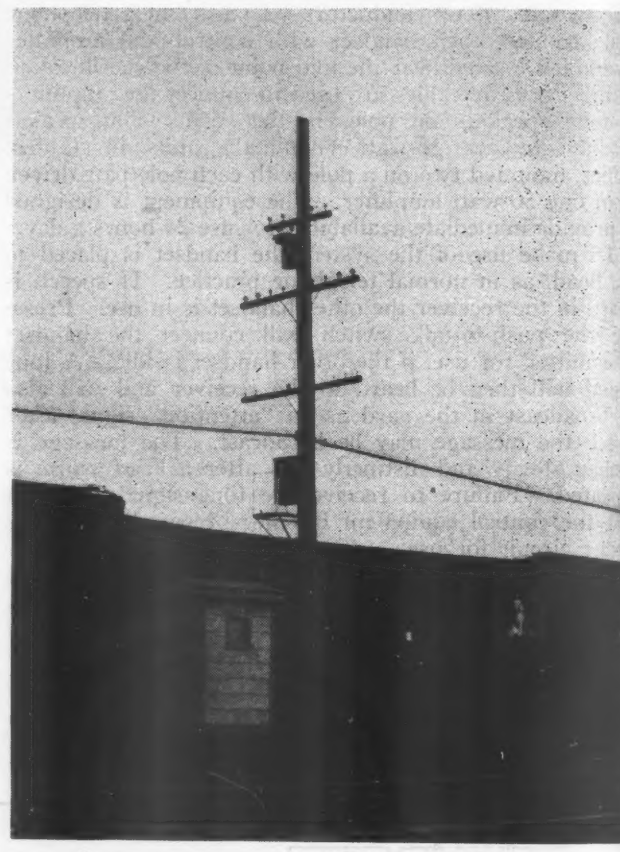
A monitoring circuit is connected from a low impedence (low energy) tap of one of the amplifiers to T 1 primary. T 1 secondary repeats the monitor circuits

One of the pairs of speakers mounted on a pole top

to the handset receivers. The circuit arrangement connected to T 1 secondary allows the monitored tone signal to reach only the handset receiver whose transmitter is ready for use. After RL 3 operates (tone signal is cut off) the monitor circuit is connected to both handset receivers.

Two "make" contact combinations are provided on RL 1 and on RL 2 for operation of relays built into the amplifiers. These relays, when operated, complete the plate supply to the tubes of the amplifiers. Until these relays are operated there is no direct current drain on the rectifier tubes.

The use of loud speakers or public address systems is not new to the Illinois Central. The railroad has equipped eight of its passenger stations with address systems for announcing the arrival and departure of trains and for paging passengers in the station. Loud speakers are also used with intercommunication systems in freight



The small building which houses auxiliary equipment for speaker operation—It is insulated and electrically heated—Power is obtained from a local power circuit through the transformer at the top of the pole

houses, freight offices, storekeepers' offices and operating offices. There are from 15 to 20 such installations.

Two outdoor systems are used in the railroad's Nonconnah yard at Memphis, Tenn., to enable the hump operator to control the manual operation of switches. Another installation at Ash street, Chicago, is used to give instructions for manual operations of switches at the crossings and connections of the Illinois Central, the Baltimore & Ohio Chicago Terminal, the Pittsburgh, Cincinnati, Chicago & St. Louis, and the Chicago Junction. There is also a loud speaker system used in the produce yard of the Chicago Produce Terminal.

The newest application of speakers on the railroad (now nearly complete) is on the platforms of an outbound freight terminal where it will serve to expedite the loading of cars. This installation will use 32 speakers.

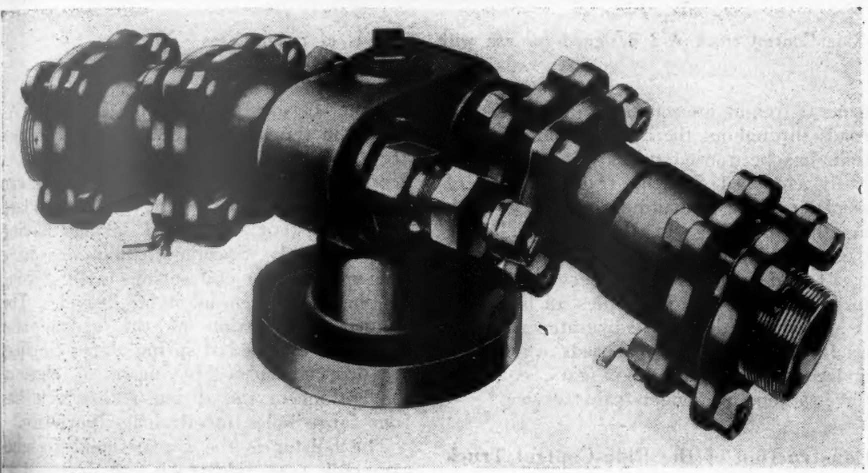
The installation described was engineered and installed under the supervision of W. M. Vandersluis, general superintendent, telegraph and signals.

NEW DEVICES

Boiler Check And Stop Valve

The Okadee Company, Chicago, has recently added a double boiler check and stop valve to its line of locomotive specialties, incorporating new design and type of construction. One innovation is the use of a horizontal, in-line, plunger-type, spring-loaded check valve instead of the conventional vertical type. This construction gives a generally straight flow of feed water through the check-valve portion to the stop valve from which it is delivered over a water spreader into the boiler below. This arrangement of the check valve offers minimum resistance to water flow and operates quietly without excessive valve pound, increasing the service life.

The boiler check and stop valve is located on top of the boiler, a short distance back of the front flue sheet, one side of the dual valve receiving feedwater from the engineman's injector and the other from the feedwater pump. The check-valve units have bronze bodies and plungers and stainless-steel renewable seats. All connections employ ball-seat joints and steel companion flanges bolted together. Another new feature is that the stop-valve body is made of cast steel with renewable monel seats, giving a strong and durable type of valve. The entire assembly is streamlined to match closely the contour of the boiler, reducing the over-all height to a minimum.

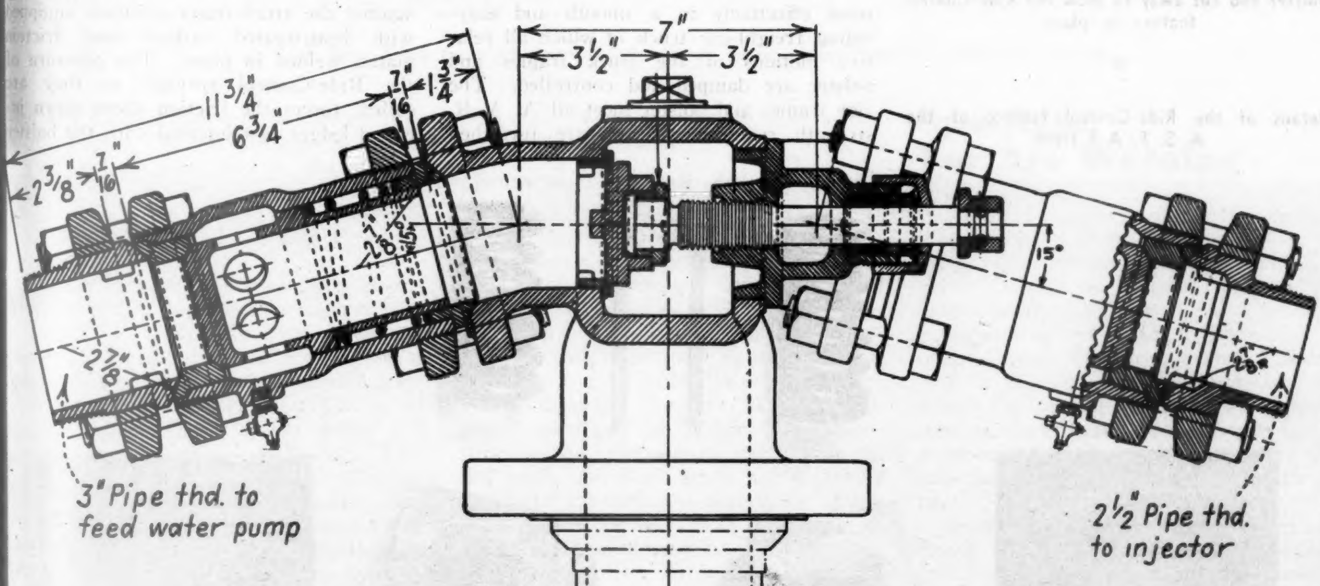


Okadee double boiler check and stop valve designed to minimize valve pound and resistance to the flow of boiler feedwater

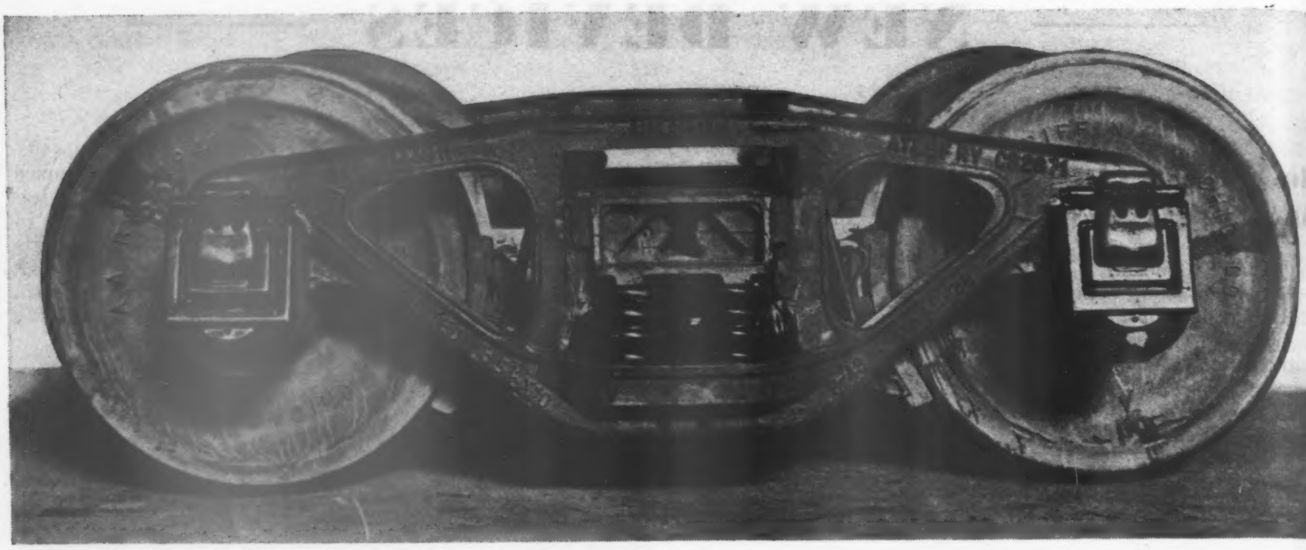
Two A. S. F. Truck Designs

As a result of extensive research including laboratory and road tests completed just prior to Pearl Harbor, the American Steel Foundries, Chicago, has developed two freight-car trucks which are intended to meet the exacting requirements of modern freight service. The first truck, which embodies a friction device for damping bolster oscillation and is known as the Ride-Control Type A-3 truck, is recommended for application to all types of freight cars. The second, or Basic truck, is essentially the same as the first, but without the friction device. The Basic truck is available for use on any freight cars which individual railroads want equipped with all-coil spring groups, or combination snubber-coil groups. Both trucks have been kept well within the weight and price range of conventional freight-car trucks.

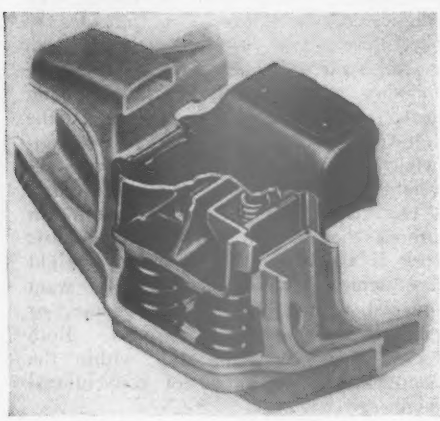
The Ride-Control truck is already in



Partial cross-section showing construction of Okadee double boiler check and stop valve



American Steel Foundries Ride-Control truck A-3 designed for use with all types of freight cars



Bolster end cut away to show the Ride-Control feature in place

◆

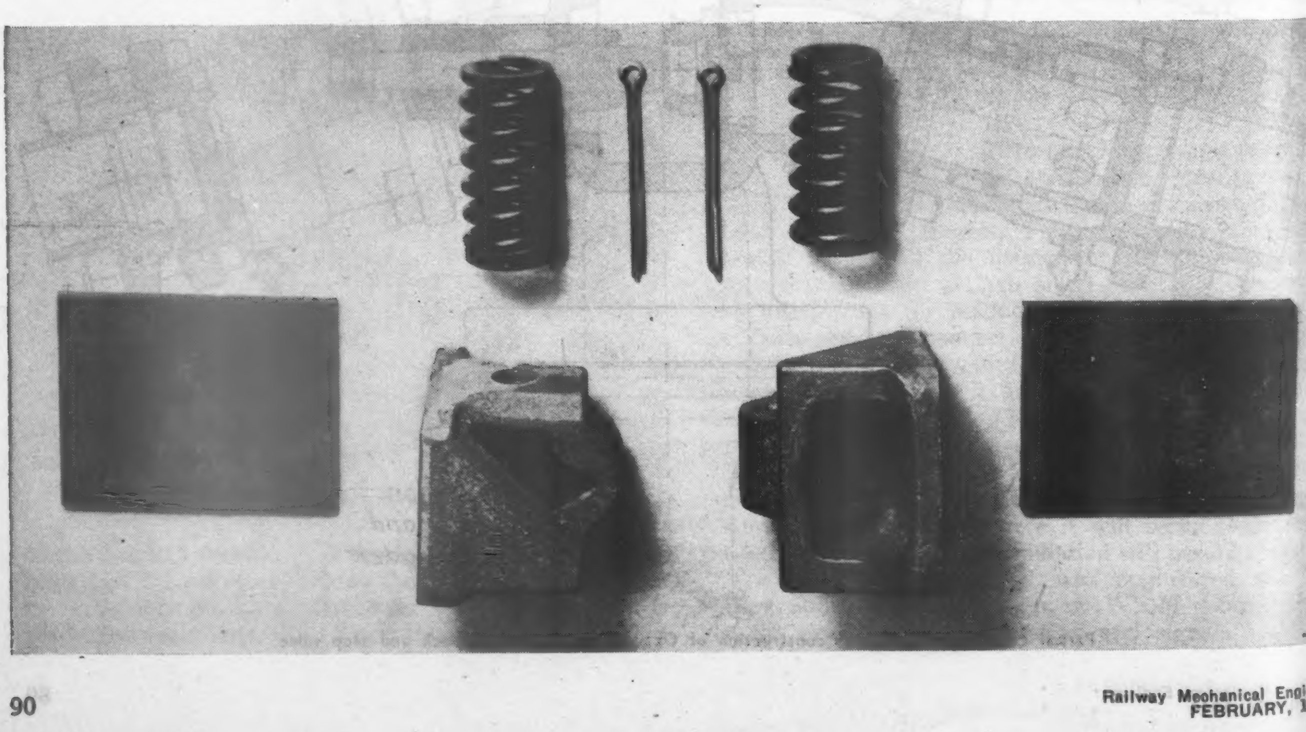
Details of the Ride-Control feature of the A. S. F. A-3 truck

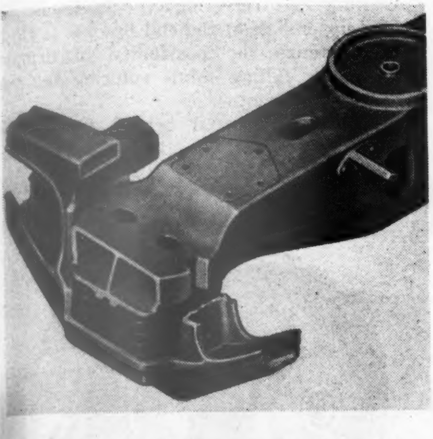
general freight interchange service on railroads throughout the country and, in addition, has been used under box cars especially equipped for the transportation of airplane wings, making unusually high monthly mileages in this service. The truck, equipped with long-travel springs, was tested in the A. S. F. Service Laboratory at speeds up to 90 miles an hour and is also reported to have operated satisfactorily at relatively high speeds when used under special express box cars, equipped for head-end passenger-train service.

Construction of the Ride-Control Truck

The A. S. F. Ride-Control truck derives its name from a type of construction intended to enable coil springs to function most effectively in a smooth and easy-riding freight-car truck in which all relative motions of the truck frames and bolster are damped and controlled. The side frames and bolster meet all A. A. R. strength requirements and are furnished in either Grade B or high-tensile steel. As shown in the illustrations, the side frames are the conventional truss design with a depressed flanged spring seat which can accommodate either A. A. R. standard coil springs, or softer coil springs having longer travel. Specific installations have been made using coil springs with 2½-in, 3$\frac{1}{16}$-in. and 3$\frac{13}{16}$-in. total travel. The flanged construction of the spring seat eliminates the need of spring plates. Springs are properly spaced by means of lugs, in the bottom of the spring seat which has four large holes for drainage purposes.

The bolster is the conventional freight-car truck type, with each end designed to incorporate a pair of special high-tensile cast iron friction shoes which are forced outward under constant spring pressure against the truck-frame columns equipped with heat-treated carbon steel friction plates, welded in place. The pressure of the Ride-Control springs, as they are called, forces the friction shoes down inclined ledges cast integral with the bolster





The bolster and side-frame connection of the A. S. F. Basic truck

also helps to control bolster side motion and restore the bolster to its normal central position as soon as the lateral force is relieved.

The equal and balanced pressures between the truck bolster and the side frames tend to hold these parts in normal alinement. The Ride-Control feature acts automatically to square the truck at all times and is said to obviate any necessity for using spring planks.

In assembling the Ride-Control truck, the friction shoes and springs are applied to the bolster and held in place with pins before the truck is put together. The bolster is then inserted through the openings in the side frames and lowered onto the truck springs. After the bolster is in place, it is pinched first to one side and then to the other while the pins are being removed. When dismantling, the reverse operation is followed.

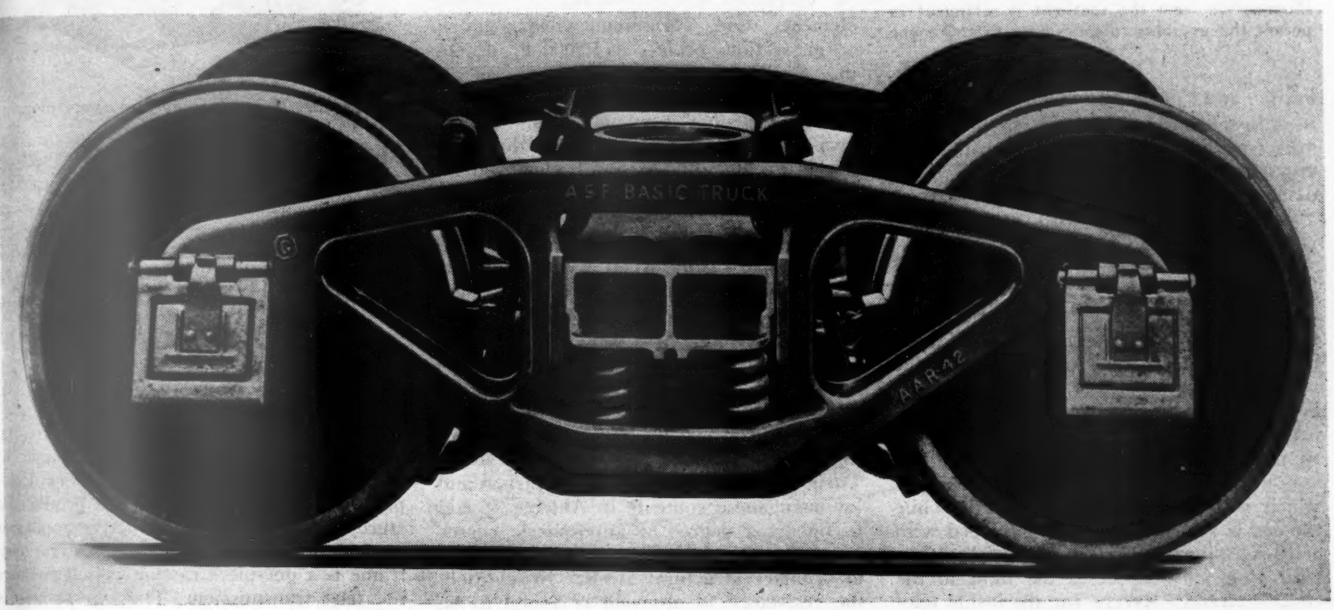
Features of the A. S. F. Basic Truck

A substantial number of the A. S. F. Basic freight-car trucks have been in interchange service on American railroads since 1940. Its performance has been tested and observed under A. S. F. Service Laboratory cars. It is in use under many thousands of freight cars and locomotive tenders built for the United States war department. Principal features of the truck include simplicity of design, rugged construction and relatively few parts. Like the A-3 truck, the Basic truck has no spring plank and the spring is held in the spring seats by positioning lugs in the bottom of a shallow drained pocket.

The truck meets A. A. R. strength requirements and is designed for use with A. A. R. standard coil springs. As shown in one of the illustrations, each bolster and side frame is held together by tongues on the side-frame columns which mesh with grooves in the bolster end. This tongue-and-groove connection is a free fit which will not bind as the bolster angles vertically in the side frame. The clearance provided limits horizontal angling of the bolster (the tendency to get out of square) to the same amount which the conventional spring-plank truck can go out of square.

The surfaces between the side frame columns and the bolster are designed to minimize column wear, eliminate binding, and assure generous contact areas as the bolster tends to angle horizontally. The truck offers no resistance to a return to squareness, such as is offered by the friction between the spring plank and the side-frame spring seat of the conventional truck. The flanged spring seat, which is an integral part of the side frame, is shown in a separate illustration.

The A. S. F. Basic truck is assembled in the usual manner and one of its important features is unusual ease of making necessary wheel changes.



A. S. F. Basic truck designed for use with all-coil spring or combination snubber-coil groups

end and outward against the column friction plates. The two springs are each compressed the same amount, when assembled in the bolster end, the amount of compression being constant and not variable with changing bolster loads or truck spring movement.

Since the pressure between the friction surfaces of the shoes and the column friction plates is always the same throughout the entire range of spring travel, only a minimum amount of friction for each fraction of an inch of motion is said to be required to control the spring action and prevent harmful spring oscillations. This construction tends to give the desired bolster snubbing effect without appreciably adding to the stiffness of the spring group, limiting its travel, or adversely effecting its softness of action when absorbing impact.

The same constant friction which controls the vertical oscillation of the truck springs, snubs or damps the lateral across the track movement of the bolster in the truck-side openings, thus cushioning lateral impacts within the limit of the bolster stops. The resistance of the truck springs to any force which tends to bend them away from their natural vertical alinement,

Spotlight For Arc Welding

A spotlight designed to produce glareless illumination of sufficient intensity for an arc-welding operator to see his work distinctly through the dark lens of a welding helmet prior to striking the arc, has been announced by the electric welding division of the General Electric Company, Schenectady, N. Y. The spotlight is especially desirable for welding in which the establishment of the arc must be made quickly and accurately, such as in the welding of thin materials, light alloy castings, and aircraft parts.

When the spotlight is used it is not necessary for the operator to lift his helmet before striking the arc. It also reduces spoilage of exacting work because the operator can strike the arc precisely where required.

Mounted on an upright, telescoping metal standard and set firmly in an 18½-in. diam., 30-lb. cast-iron base for stability, the spotlight consists of three 300-watt reflector spot lamps surrounded by a circular shade. Rated to give 1,000 hours of continuous op-

Illumination from the spotlight is sufficient to permit the operator to see where to strike the arc

eration at 120 volts, the lamps are mounted in adjustable porcelain holders, so that the area covered by the light beam can be increased from a single, sharp spot 7 in. in diameter to a clover leaf shaped pattern approximately 17 in. across at its widest point.

The light can be raised or lowered on its standard, and held securely in place by a locking thumb screw, to any point from 45 to 76 in. above the base. A universal, friction ball-joint between the shade and the upright standard permits the light beam to be directed and held at any angle downward between vertical and 30 deg. below horizontal.

Controlled by a foot-operated switch which is depressed by the operator while the arc is struck, the unit is equipped with a 10-ft., oilproof, heavily jacketed cable, with plug for connecting the light to the electric circuit. Except for the inside telescoping section of the standard, the entire unit has an attractive black crackle finish, and is furnished completely wired and ready for operation.

A Low-Alloy High-Strength Steel

A patented high-strength steel developed for application in the design of structures such as freight and passenger cars as well as for other structural uses has been announced by the Alloys Development Company, 11 East Forty-Fourth street, New York. Known by the trade name Aldecor, the steel will be available from a number of producers who are being licensed under the patent. The War Production Board has recently lifted some of its restrictions on critical alloying elements where the material produced is to be used in important applications; among them freight and mine cars are included. Aldecor is produced as a low-carbon open-hearth steel which contains small percentages of molybdenum, copper, silicon and phosphorus and is used in the as-rolled condition without further treatment.

A typical test heat of 200 tons had the following analysis: C .07, Mn .25, P .095, S .031, Si .48, Cu .42, and Mo .20 per cent. The physical properties of this steel are shown in the table. The steels, as produced, may contain alloying elements within the following range: carbon, from .06 to .12; molybdenum, from .18 to .30; copper, from .35 to .55; silicon, from .45 to .65, and phosphorus, from .08 to .13 per cent. The strength properties of the steels produced, both as to tensile and yield strengths, can be increased or decreased within limits by variations in the amount of alloying elements used. Minimum yield point in ½-in. sections or less is 50,000 lb. per sq. in. Such differences in strengths as are desired are obtained principally by varying the molybdenum content. High-strength properties are obtained with little sacrifice in the ductility of the product and the steels are, therefore, well adapted for either hot or cold forming. The steels within the composition range given do not harden appreciably when cooled suddenly from high temperatures, a feature of importance in connection with the use of ordinary commercial welding processes. The low carbon content also makes for good weldability.

The alloying elements—molybdenum, copper, silicon and phosphorus—are known to impart corrosion resistance to steels. Their combination with the low-carbon and low-manganese contents in Aldecor is said to impart a degree of atmospheric corrosion resistance several times that found in ordinary structural steels. In addition, the resistance to abrasion is found to be substantially greater. Weight saving by the use of these steels is not obtained because they are lighter in weight than given sections of ordinary low-carbon steels, but because their high-strength, corrosion- and wear-resistant qualities make it possible for engineers to use less steel in the design of structures.

The alloying elements employed are all found in generous quantities within the United States. In addition, the molybdenum and copper are fully recoverable from scrap steels of this composition.

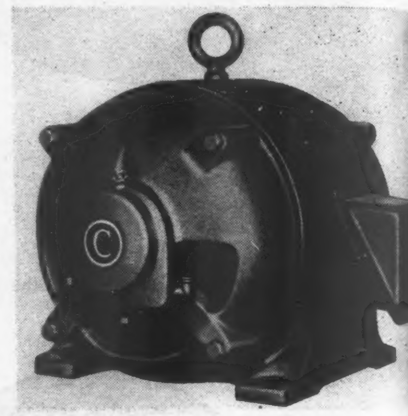
Physical Properties of a Test Heat of Aldecor Steel, as Rolled

Direction	Gauge	Yield point, P.S.I.	Tensile strength, P.S.I.	Per cent elongation in 8 in.	4 in.	2 in.	Per cent reduction
L	.062	61,910	76,150	22.5	28	36.5	36.2
T	.062	70,430	78,980	18.5	25.5	32	36.3
L	.500	48,270	69,480	24	31	40	45.3
T	.500	47,580	72,680	18	25	36	46.0

General Purpose Protected Motor

General purpose, open-rated motors in a new protected design have been made available in sizes from 1½ to 15 hp. by the Century Electric Company, St. Louis, M
The upper half of the end bracket is clos
to minimize the possibility of drippin
liquids or falling solids entering the vit
parts of the motor.

Two fans located behind the bearin



Century, Form 4, general-purpose motor

brackets draw cooling air through the bear
ing bracket openings, around the bearings
across the windings and to the air passage
between the outer surfaces of the magnetic
core and the frame. The heated air is ex
pelled through openings at the side and bot
tom of the frame.

Cabinet Planer

Redesigning of a 24-in. cabinet planer by
the American Saw Mill Machinery Com
pany, Hackettstown, N. J., has produced a
sturdy, efficient and attractive-appearing
machine for woodworking shops. The main
frame is a one-piece casting which encloses
the feed transmission. The top section is
also of one-piece construction and supports

Cabinet planer redesigned for greater rigidity—Moving parts are enclosed to reduce operator hazards

the cutter head, chip breaker, pressure bar
and the two upper feed rolls. All moving
parts are enclosed. The bed casting is made
in one piece and has a removable center-
bed platen. The feed mechanism is con-

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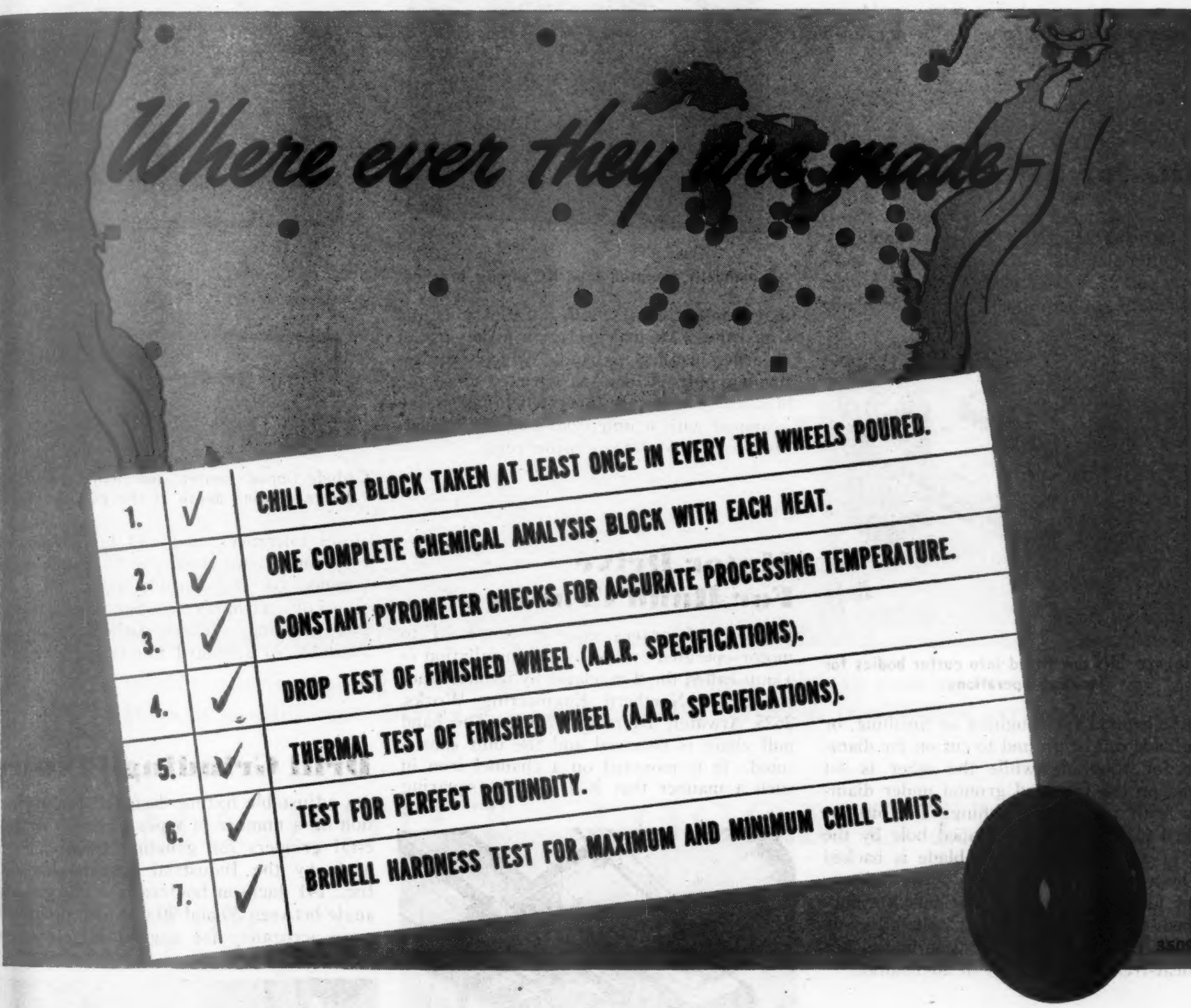
7 TESTS Ensure Uniformity of CHILLED CAR WHEELS



All member companies of the Association of Manufacturers of Chilled Car Wheels have their output rigidly tested by Association inspectors. In this manner, the approval of all Chilled Car Wheels is up to impartial resident examiners who release the product only if it meets all of the specifications established as standard for the industry. All this—decidedly unusual in *any* association—is done for the protection of the American Railroads. Thus, a good wheel is standardized wherever it may be made or bought.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

AMCCW

230 PARK AVENUE, NEW YORK, N. Y. • 445 N. SACRAMENTO BLVD., CHICAGO, ILL.

ORGANIZED TO ACHIEVE:

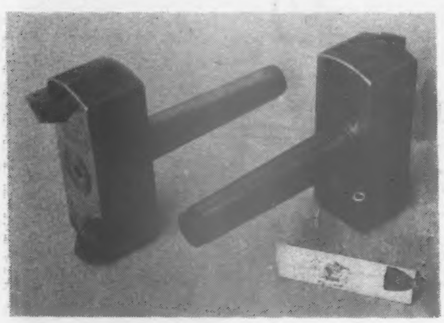
UNIFORM SPECIFICATIONS • UNIFORM INSPECTION • UNIFORM PRODUCT

trolled by the operator through a hand wheel with speeds ranging from 20 ft. to 30 ft. per min. A foot pedal release for the feed is provided as a safety feature. Feed rolls are driven by chains operating on hardened-steel sprockets.

Three or four-knife cutter heads can be furnished and they are mounted in ball bearings. A rotating index plate has an index pin for locating the knives accurately for jointing or grinding operations. All main revolving parts are equipped with ball bearings and are lubricated by an Alemite pressure system. Direct-drive motors of 5- or 7½ hp. are used.

Bits for Fly Cutters

Tri-Bits, manufactured by Weddell Tools, Inc., Rochester 7, New York, are applied to fly cutters, made with one or more teeth, set at suitable rake and shear angles for desired milling operations. The cutter blades



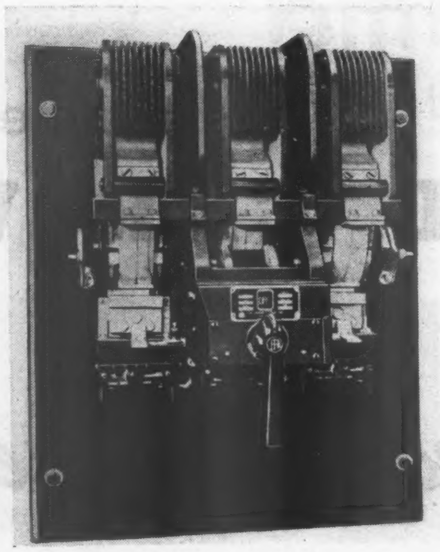
Triangular bits are fitted into cutter bodies for milling operations

can be ground for roughing or finishing, or one blade can be ground to cut on the diameter for roughing while the other is set ahead on the face and ground under diameter with a lead for finishing. The bits are locked in place in a V-shaped hole by the use of a lock screw. The blade is backed up by a single lock screw to permit adjustment for size or wear. The bits are furnished in high-speed steel, cast alloy or carbide tipped units; the cutter bodies are of heat-treated alloy steel or Meehanite.

Air Circuit Breaker

A trip-free air circuit breaker, known as type KC, with an interrupting rating of 50,000 amp., is offered by the I-T-E Circuit Breaker Company, Philadelphia, Pa. Ratings are 600 volts a.c., 250 volts d.c., 100 to 1,600 amp. Operation may be either manual or electric and the breaker is made with one, two, and three poles. Mounting may be on open-type (live-front) or dead-front switchboards or in individual steel enclosures of general purpose or weather-proof construction.

Construction features include silver alloy main contacts brazed to solid copper contact blocks, auxiliary and arcing contacts which are also made of silver-alloy and

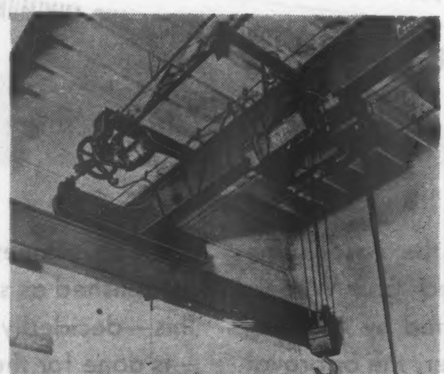


A manually operated type KC circuit breaker

magnetic arc chutes with blowout coils and iron vanes. Manual operation makes use of a large, pistol-grip handle which requires turning only 90 deg. to open or close the breaker. Electrically operated breakers are equipped with a unit type solenoid mechanism and a trip-free closing relay.

Motor Drive For Hand Cranes

Hand-travel cranes can be converted to motor-operated cranes by the installation of a unit called the Travelator by its manufacturer, the Northern Engineering Works, 2625 Atwater, Detroit 7, Mich. The hand pull chain is removed and the unit substituted. It is mounted on a channel iron in such a manner that it drives the squaring



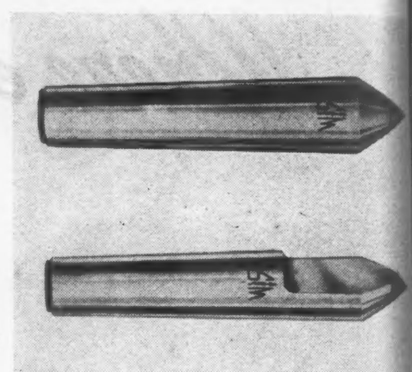
Unit which can be used to convert hand cranes for motor operation

shaft through a split sprocket which is mounted on a split clamp so that it can be applied without removing the squaring shaft. Control is through a pendant-cord pushbutton which can be mounted to travel with the crane carriage. The unit can be placed at any position on the squaring shaft although it is usually near the end. The motor can be located at any angle and is held in position by an adjustable steel band.

Lathe Centers With Carbide Tips

Longer service life of the new lathe cent[ers] and half centers, made by the Wendt-S[...] Company, Hannibal, Mo., is achieved [by] the extension of the carbide insert [into] the shank of the tool. This extension [is] approximately equal to the exposed port[ion] of the tip allowing extra regrinds befo[re] need of replacement, should the bear[ing] surface of the tip become damaged.

These lathe centers are guaranteed [to] have a concentricity within .0002 in. or le[ss] permitting finish grinding and turning [to]

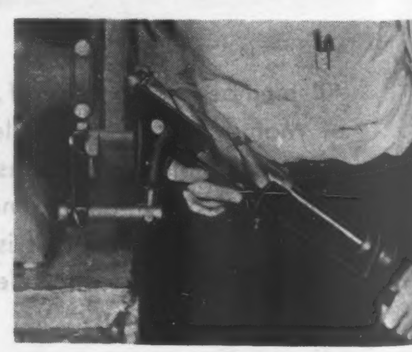


Carbide-tipped center and half center, the latter showing depth of the carbide insert

closer tolerances, and will hold this accuracy for a long time, due to the wear resistance of the carbide tip. They are especially advantageous for finish turning and grinding. These lathe centers are available in standard tapers and sizes.

Drill Grinding Fixture

An adjustable fixture designed for application on a number of types of bench or pedestal grinders for grinding twist drills is made by the Industrial Engineering Co., Inc., 141 Jackson boulevard, Chicago. Any angle between 30 and 90 deg. can be ground more accurately for angles and clearances



A fixture which assures for the accurate grinding of twist drills

than is possible ordinarily by hand grinding. Preparation of drills by the use of this fixture is said to prevent oversize, off-center holes, improve work quality, add to drill life and increase production.

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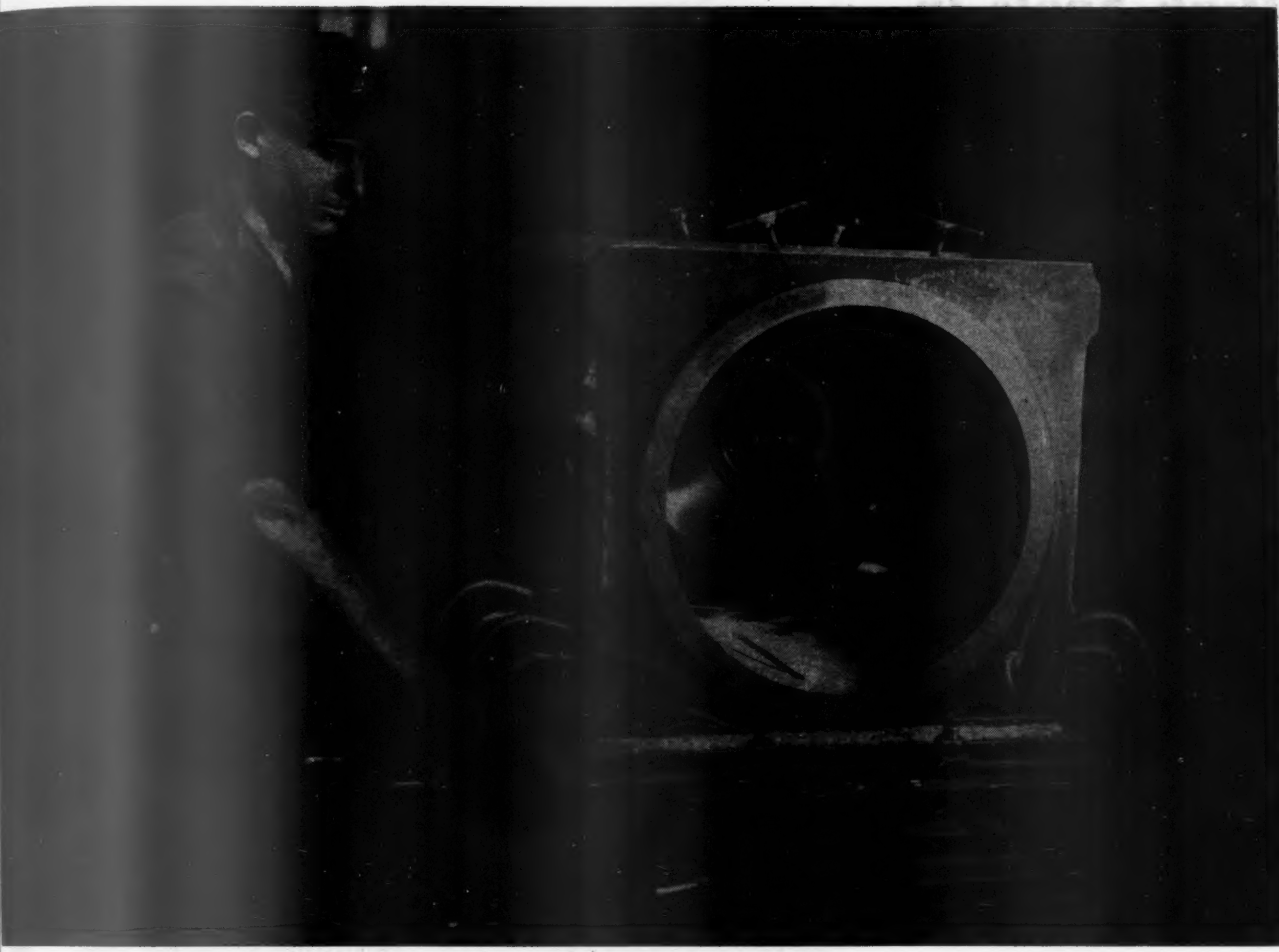

With modern grinding equipment Lima gives a mirror finish to wearing surfaces. Here is a solid type driving box being prepared for long, trouble-free service.

High Spots in
Railway Affairs . . .

Brig. Gen. Gray Honored

The Legion of Merit has been awarded for "exceptionally meritorious conduct" to Brig. Gen. Carl R. Gray, Jr., director general of military railways. The successful development and operation of all railways within the North African theatre of operations, "a colossal task," says the citation, "is a tribute to his tireless energy, keen judgment and inspiring leadership. He has surmounted countless obstacles to effect the movement of tremendous quantities of supplies and equipment and numbers of personnel."

Ton-Miles in 1943

Changed freight car loading and operating conditions on the railroads have made worthless the former measuring stick of revenue freight cars loaded as a gage of the actual amount of traffic handled. The latest available estimates, based on actual figures for the first ten months and estimates for November and December, indicate a total of 725,447,456,000 ton-miles carried in the year 1943, an increase of 13.7 per cent over 1942.

Germans Lose Locomotives

The term logistics has come into quite common use in these war days. American railroads have had their difficulties, but have made good in a decided fashion in meeting the exacting requirements to which they have been subjected. Germany is quite as dependent upon transportation as are the Allies. Even though it has appropriated railway equipment from subjugated countries it has a tremendous task to supply the needs of its armed forces—and the Allies are not making it any easier. According to the Railway Gazette of London, officially compiled summaries show that the bombing of Germany and occupied territories from bases in Great Britain has resulted in the destruction of nearly 200 locomotives a month. "The Russian official summary of gains between July and November," says the Railway Gazette, "mentions the capture of more than 400 and the destruction of more than 300 locomotives. It appears, therefore, that the German transport facilities are losing locomotives through air attack at the rate of more than 300 a month. This is irrespective of Polish activity, of which no estimates can be given." In light of these facts it is rather surprising to note from a current news report that under the Turkish-German clearing agreement, Germany has delivered 15 locomotives and several hundred freight cars to Turkey during the past month. It is understood, however, that these are to be used only for commerce between Turkey and Europe, moreover, the equipment is in exchange for chrome, cotton, and other much needed imports from Turkey.

Freight Car Construction

The war years have proved an intensive testing period for railroad equipment. Old and obsolete equipment, practically discarded under normal conditions and used only in times of emergency, has been put back into regular service. It is expensive to operate and maintain, but it is helping the railroads to make good in meeting the heavy demands upon them. All of the equipment is being utilized intensively and to the limit. This has served to focus attention on the weak spots—the performance of the more modern designs has been brought into sharp contrast with that of the older ones. Several chief executives recently spoke at the Railroad Presidents' Day luncheon of the annual meeting of the Mid-West Shippers' Advisory Board. They indicated that the post-war years would be characterized by a more attractive service to shippers and travelers at low cost, and a more extensive use of light-weight passenger and freight cars. In speaking of freight cars, Col. Ralph Budd, president of the Chicago, Burlington & Quincy, said that "the design and construction of light-weight freight cars, which will weigh less but carry more pay load, was only beginning to materialize, and of the two million freight cars on the railroads today an insignificant percentage are of this type.

Significant Trends

The Bureau of Transport Economics and Statistics of the Interstate Commerce Commission publishes a Monthly Comment on Transportation Statistics. The last report available when this was written, January 8, indicated that operating expenses of Class I railways were up 23.6 per cent in November, 1943, compared with November, 1942, "which is in marked contrast with the 10.4 per cent for revenues." The operating ratio rose from 58.9 to 65.9 per cent. The increase was due to higher wages, higher accruals for depreciation and amortization, increases in prices of materials and a higher level of traffic. The average net ton-miles per freight-train mile was higher in each month of 1943, January to October, than in the corresponding months in 1942. For October the average was 1,162 tons, or 5.5 per cent more than for the previous October. For the ten months period it was 8.4 per cent more than for the corresponding period in 1942. For the first ten months the average gross ton-miles was 36,079 in 1943 and 35,865 in 1942. The number of women employed by Class I steam railways increased from 63,187 in the middle of January, 1943, to 103,209 in mid-October.

Manpower Situation On Railways Serious

"One good railroad man on a railroad is worth a thousand railroad men in the Army." Thus spoke Interstate Commerce Commissioner J. Monroe Johnson in a hearing before a special Senate interstate commerce subcommittee investigating the railroad transportation situation. "The railroad man is already in a vital military job," he said. It is estimated that there are now about 250,000 railroad men in military service. Commissioner Johnson estimated that there was a 15 per cent shortage of manpower on the railroads today, or about 222,000 employees. In discussing the effect of a possible railroad strike, in response to a question from Senator Reed, he said it would prove "a military catastrophe beyond expression." "Damn near treason?" queried the Senator. "Worse than treason," replied the Commissioner, and then added: "I don't think we have a military agency more important than the railroads. We would lose on all fronts without them."

Accidents Increase

The fifty-seventh annual report of the Interstate Commerce Commission points out that "the number of train accidents reported by steam railways has continued to increase faster than the locomotive-miles or car-miles." For the first six months of 1943 there was an increase of train accidents, compared to the same period of 1942, of 31.72 per cent. The rate per million locomotive-miles was 9.20 as compared to 7.63 in 1942. The rate per million car-miles increased from 0.341 for the first six months in 1942 to 0.409 for the same period in 1943. Comparing the increases in train accidents for the first six months of 1942 and 1943 we find that there was an increase in the latter year of 39.15 per cent in those ascribed to defects in or failure of equipment; 46.66 per cent in those ascribed to defects in or improper maintenance of way and structures; 29.51 per cent in those reported due to negligence of employees; and 15.28 per cent in those due to unclassified causes. The report emphasizes the fact that "neglect to repair what may appear at the time to be an insignificant defect to an unimportant part, may result in accident or injury, as well as delay in traffic."

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Among the Clubs and Associations

Boiler Makers to Meet in September

THE Master Boiler Makers' Association will hold an annual business meeting the third week of September at the Hotel Sherman, Chicago.

Advanced Passenger Car Design

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—Meeting held January 20 at Atlanta, Ga. Speaker: Col. E. J. Ragsdale, chief engineer, railway division, Edward G. Budd Manufacturing Company. Subject: Advanced Passenger-Car Design. —Predicting that the railroads "will face a postwar passenger business larger than they have ever experienced," believes the carriers will require "at least 15,000 new passenger cars" to accommodate their prospective traffic.

Colonel Ragsdale outlined design considerations, the use of stress calculations, and methods developed in the aircraft industry and modified to meet railroad conditions. He said in part: ¶ "The railroads have as big a postwar travel market as they care to make it. [He predicts that the railroads "will face a postwar passenger business larger than they have ever experienced," and believes that the carriers will require "at least 15,000 new passenger cars" to accommodate their prospective traffic.] It only requires merchandising and that is a profession we've learned something about during the decade of the streamliner. The formula calls for finding out what the public wants and giving it to them—in an attractive package. That we were headed in the right direction to accomplish this is proved by the record of the Pioneer Zephvr which the Budd Company built for the Burlington in 1934. That train, nearing its tenth birthday and its 2,000,000th mile of operation, has paid for itself six times over and established a precedent which can guide us in the development of the trains of the future. ¶ "One phase of the railroad's bid for postwar travel will be the increased number of all-coach trains. The percentage of occupancy will be high and that is a far more important issue than is that of first cost or the expense of operation. With the Armistice signed, this new public will immediately want to get rid of rationing, restrictions and discomforts endured patiently during an emergency. It's going to want luxury for a change. The sooner the railroads can accommodate themselves to this desire the greater will be their postwar business. ¶ "There are those who expect the postwar train to look like a superman's dream of streamline design and embodying the use of presently little-known materials, such as new plastics. These hopes will bring only disappointments. The radical changes of design have happened. They had already simmered down to the improvement stage when we got into the war. This improvement will continue. As to new materials, there will be new price structures and new capacities for old materials but no radical switching or substitutions. It is not going to be a plastic world. ¶ "Aviation has had the benefit of magnificent research, both in regard to air behavior as well as to structural sufficiency. Car building, on the other hand, has grown up the hard way, so to speak. After a hundred or more years of building railroad cars, the first laboratory for the testing of a complete railroad car was built in 1940. It is still the only one in the world. Yet good railway cars have been built and nowhere are they built better than in the United States. ¶ "When Budd built its first lightweight stainless steel car, ordinary passenger cars weighed as much as 160,000 lb. In 1932 they averaged only twelve passengers per coach which meant over 13,000 lb. of car per passenger. Naturally, this was uneconomical. To meet this problem, it was necessary to cut the car weight and put more passengers in it. New and stronger alloys made the first possible while streamlining did the rest."

1944 Electrical Section Officers

OFFICERS of the Electrical Section, Engineering Division, Association of American Railroads, have been selected for the period January 1, 1944, to December 31, 1944. They are as follows: Chairman, D. B. Thompson, mechanical and electrical engineer, New York Central, and vice-chairman, J. M. Trissal, engineer fixed property, Illinois Central.

Elected to the Committee of Direction for the term January 1, 1944, to December 31, 1944, are: J. M. Trissal, engineer fixed property, Illinois Central, H. F. Brown, assistant electrical engineer, New York, New Haven & Hartford, and R. J. Needham, mechanical and electrical engineer, Canadian National. Elected for the term January 1, 1944, to December 31, 1945, are: J. E. Gardner, electrical engineer, Chicago, Burlington & Quincy; R. Beeuwkes, electrical engineer, Chicago, Milwaukee, St. Paul & Pacific, and S. R. Negley, electrical engineer, Reading; and for the term January 1, 1944, to December 31, 1946, D. B. Thompson, mechanical and electrical engineer, New York Central; K. H. Gordon, assistant electrical engineer, Pennsylvania, and Paul Lebenbaum, electrical engineer, Southern Pacific.

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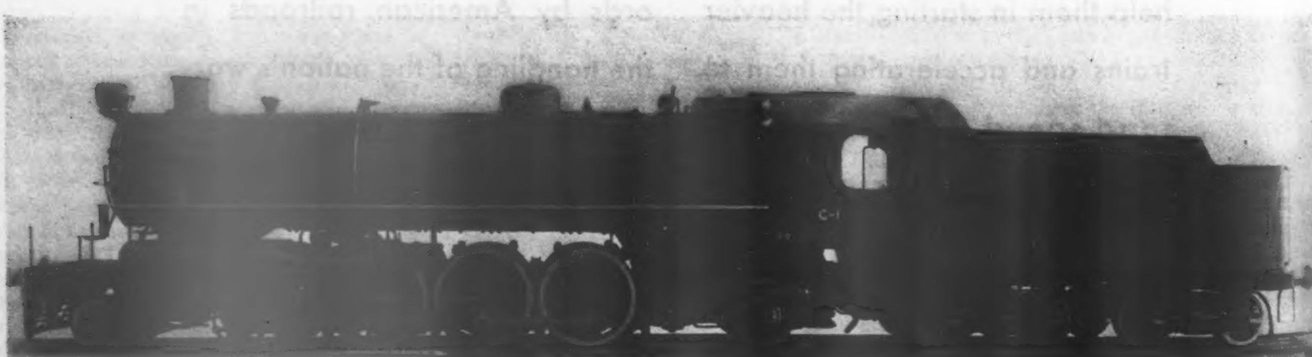

Wide-gauge locomotives being built in Canada for the Indian State Railway—The Canadian Pacific is supervising the construction and its representative will have charge of their re-erection in India

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NEWS

Proceedings Boiler Makers' Association, 1943

THE reports and addresses prepared by various committees of the Master Boiler Makers' Association for 1943 are now available in the Proceedings for that year. The book costs $5 and can be obtained from the secretary-treasurer, A. F. Stiglmeier, 29 Parkwood St., Albany 3, N. Y.

All Transportation Records Broken in '43

REVIEWING railroading in 1943, J. J. Pelley, president of the Association of American Railroads, in a year-end statement, reported that "all transportation records were broken" last year as the railroads handled "the greatest volume of freight and passenger traffic in their history." His statement continued as follows:

"Freight traffic moved by the railroads in the current year amounted to 725,000,000,000 ton-miles. This was an increase of 14 per cent above that for 1942, the previous record year, and 117 per cent more than in 1939. It was more than one and three-quarters times the volume moved in 1918, the peak year of World War I. Freight-car loadings in 1943 approximated 42,350,000 cars, a decrease of 475,000 cars or 1.1 per cent below 1942. [Later A. A. R. figures show total carloadings of 42,414,343 in 1943, a decrease of 412,120 cars, or 1.0 per cent over 1942.] Heavier loading of freight cars and longer hauls per ton accounted for the increase in the ton-mile volume of freight, contrasted with the decrease in the number of cars loaded.

"Passenger traffic in 1943 was by far the greatest for any year in railroad history. It amounted to 85 000,000,000 passenger-miles. This was an increase of 58 per cent above 1942, twice what it was in 1918, and nearly four times what it was in 1939. The heavy movement of passengers in 1943 can be attributed in part to Army troop movements, more than ten million men having been moved in special trains and special cars. This does not include the millions of soldiers, sailors, and marines on furlough who traveled during the year, nor does it include small groups of individuals moving on order, nor Navy and Marine Corps movements, nor prisoners of war.

"On the basis of the present outlook, freight traffic in 1944 is expected to increase between two and five per cent. An increase of between 10 and 20 per cent in passenger traffic is anticipated.

"Outstanding operating records established by the railroads in 1943 follow:

"1. Average load of freight per train was 1,116 tons, the highest on record. In 1942 it was 1 035 tons.

"2. Performance per freight train more than doubled in 20 years, gross ton-miles per freight train-hour having increased from 16,764 in 1923 to 36,079 in 1943, while net ton-miles per freight train hour increased from 7,770 in 1923 to 17,022 in 1943.

"3. The average load per car of carload freight was 41 tons in 1943 compared with 40.1 tons in 1942.

"4. Average daily movement of freight cars was 51.2 miles in 1943 compared with 48.8 miles in 1942.

"5. Average haul of freight was 480 miles in 1943, compared with 428 miles in 1942.

"6. The average number of passengers per car and per train was much greater than ever before.

"7. Average daily movement of both freight and passenger locomotives attained a high record, that of the former being 125 miles compared with 122.4 miles last year and the latter, 220.3 miles compared with 206.8 miles one year ago.

"8. Average revenue for hauling a ton of freight one mile was 0.933 cents compared with 0.932 in 1942. These averages are the lowest since 1918.

"9. Average capacity of freight cars was 50.8 tons at the end of 1943, the highest on record.

"10. Tractive force of steam locomotives average 52,548 lb. at the end of 1943, the highest ever recorded and an increase of 34 per cent compared with 20 years ago.

"The increase in freight traffic was handled this year by the railroads in the face of an increase of less than one per cent in the number of freight cars and an increase of only 1.4 per cent in the number of locomotives owned. There was no appreciable change in the number of passenger cars owned.

"Railroads in the first eleven months of 1943 installed in service 26,433 new freight cars and 656 new locomotives. They had on order on December 1, 1943, 36,253 freight cars and 1,004 locomotives. In order to take care of increased traffic and replace worn out equipment, they are expected to need between 40,000 and 50,000 new freight cars and about 1,200 locomotives by next October."

Frisco Budget Provides $1,867,635 for Mechanical Improvements

THE budget of the St. Louis-San Francisco provides for the expenditure of $5,845,429 for improvements in 1944. Of this amount $1,867,635 is for mechanical improvements, including $1,522,572 for rebuilding 600 hopper cars in the company's shops, $306,507 for improvements to locomotives, and $21,958 for equipping five first-class passenger cars with 31 bucket-type seats per car.

The budget also provides for the purchase of new machinery for the company's repair shops at Springfield, Mo., and 50 flange oilers.

Railroads Consider Purchase of 17,450 New Freight Cars

APPLICATIONS for new freight-car equipment pending as of the week ended January 15 totaled 17,450 cars, sought by 34 different railroads. Included in the contemplated 17,450 cars to be purchased are 9,400 box cars, 3,750 hopper cars, 3,300 gondola cars, and 1,000 miscellaneous cars, types of which are not disclosed. Presumably all or most of the new cars will be of all-steel construction, since the War Production Board has abandoned its insistence on the so-called composite-type car.

The backlog of cars on order for the railroads as of January 1, totaled 36,580 of which 33,100 were released for building by the War Production Board and 3,480 were without WPB authority to build. Placing of orders for the additional 17,450 cars contemplated would raise this backlog to 54,030 cars, as compared with the proposed 1944 building program of 50,000 cars announced by the WPB in December, 30,000 to be of all-steel construction, and as compared with total production for domestic service during 1943 of 31,591 cars.

The 33,100 cars on order and authorized for building for the railroads as of January 1 are divided 19,770 with contract car builders and 13,330 with railroad shops, and comprise 700 automobile, 12,290 box, 13,546 hopper, 4,720 gondola, 1,370 flat, 50 refrigerator, four air-dump, and 420 caboose cars. Included are about 3,100 cars remaining to be shipped of the number authorized by the WPB out of steel allotted for the third quarter, 1943; 9,900 remaining of WPB authorizations from fourth quarter, 1943 materials; 9,500 from first quarter, 1944 materials; 7,700 released from authorized advance allotments of steel for the second quarter, 1944; 2,000 from third quarter, 1944 materials, and 900 from fourth quarter, 1944 materials.

Over 21,000 Women in Equipment Maintenance and Stores Work

WOMEN employees of Class I roads increased from 94,466 to 103,209 during the three-months' period from mid-July until mid-October, last year, according to the latest figures issued by the Interstate Commerce Commission's Bureau of Transport Economics and Statistics. The statement, made public on January 4, is the fourth quarterly compilation of statistics of this nature.

The 103,209 women employees reported as of the middle of October represents 7.55 per cent of all employees reported. The latter compares with 6.79 per cent as of mid-July, 6.09 per cent as of mid-April, and 4.79 per cent as of the middle of January, 1943.

The present compilation shows that the increase in the number of women during the three-month period was distributed

among all classes of employment, except the group embracing executives, officials, and staff assistants, which included 18 women in mid-October, the same number reported for mid-July. Meanwhile, women in the other groups increased, those in maintenance of equipment and stores from 19,548 to 21,734. Coach cleaners comprised the largest group of women in this work as of mid-October. Next in turn came 5,353 general laborers in shops, enginehouses and power plants, and 5,067 skilled trades helpers. Also, there were 100 women machinists, and 130 gang foremen in shops, enginehouses, and power plants.

Mann Appointed Director of W. P. B. Equipment Division

ALBERT C. MANN, vice-president of the Illinois Central, has succeeded Lynne L. White as director of the War Production Board's Transportation Equipment Division. Mr. Mann took over last month when Mr. White, who had served three months as successor to Andrew Stevenson, returned to his position as chief operating officer of the Chicago & North Western.

A. A. R., Mechanical Division

EMERGENCY DESIGN OF JOURNAL BEARING IS WITHDRAWN

According to a circular letter dated January 3 from the secretary of the A. A. R. Mechanical Division, the General Committee has considered the effect of the Emergency journal bearing design in service and, after a thorough discussion, unanimously decided to recommend that the Emergency design be abandoned and the A. A. R. standard bearing in use prior to the adoption of the Emergency design be re-instated. The secretary reports that this recommendation has been approved by the War Production Board as the situation is now such that it is no longer necessary to continue the Emergency design for journal bearings.

As a result of this action by the General Committee, therefore, the Emergency design of journal bearing has been withdrawn, together with Emergency Page E-D-24-October 1, 1942, in Sec. D of the Manual of Standard and Recommended Practice. Journal bearings for the future will conform with the standard design corrected to January 1, 1942, shown on Page D-24-1942, Sec. D of the Manual.

GEARED HAND BRAKES

Following the adoption of A. A. R. specifications for geared hand brakes by letter ballot last year, the various manufacturers of geared hand brakes were invited to submit their brakes for test and make application for certificate of approval. As of January 3, the Mechanical Division reports that applications have been received, satisfactory tests conducted and certificates of approval awarded by the Committee on Geared Hand Brakes to the following manufacturers: Ajax Hand Brake Company, Drawing 14038; Champion Brake Corporation, Drawings 1148 and 1124; Klasing Hand Brake Company, Drawing D-959; W. H. Miner, Inc., Pattern D-3290-X; Superior Hand Brake Company, Drawing 566; Universal Railway Devices Company, Drawing 5700.

LIGHT-WEIGHING AND STENCILING OF TANK CARS

Interchange Rule 30 specifies that tank cars must be reweighed and restenciled only by owners or their authorized representatives. In a circular letter dated January 13 the vice-chairman of the Mechanical Division reports that quite a large number of tank cars are in service with entirely illegible lightweight markings, making it necessary for the cars to be light-weighed before being placed for loading by shippers. This extra switching and delay in re-weighing cars before each loading places some additional and largely unnecessary burden on already overtaxed rail transportation and tank car owners are urged to check carefully the weight markings on their individual cars and, if found illegible, arrange to reweigh and restencil or authorize railroads to perform this work.

PIPE UNIONS IN TANK CAR HANDRAILS

Mr. Hawthorne, in a circular letter dated January 13, calls attention to a previous letter dated September 21, 1942, from Secretary A. C. Browning, emphasizing the necessity of prohibiting the use of pipe unions in tank-car handrails in conformity with I. C. C. regulations. Apparently these unions are still being applied and maintained in some instances, and tank car owners are urged to take necessary action to have these unions removed from handrails on their cars wherever found and have pipe couplings applied in place of the unions.

THE CAUSE AND PREVENTION OF HOT BOXES

In a circular letter, dated January 13, the vice-chairman of the division calls attention to favorable results with various types of packing-retaining devices in keeping journal-box packing in place and preventing waste grabs and states that the General Committee desires particular care exercised in replacing these devices, unless defective, in all cases of wheel removal or periodic repacking of journal boxes. All railroads and private car owners are requested to issue necessary instructions for the protection and continuance of these packing-retaining devices in service as long as they are in serviceable condition. In this connection, Mr. Hawthorne states that the application of loose wooden sticks as packing retainers in journal boxes has not been found satisfactory and their use is not encouraged.

Correction—Selection of Motive Power

IN the article entitled, "Selection of Motive Power" in the January, 1944, issue the first line in Table III appearing on page 5 should read: "Freight, 1,000 g.t.m. incl. loco. (000's)" and the figure in the fourth column of the same line should be 13,506 instead of 12,506.

1943 Report of the Bureau of Safety

THE annual report of Director S. N. Mills of the Interstate Commerce Commission's Bureau of Safety for the fiscal year ended June 30, 1943, is a 39-page document setting forth in the usual form the results of inspection of safety-appliance equipment on railroads together with information on the hours-of-service records of employees, installations of signaling facilities, investigation of accidents, and other activities of the Bureau.

During the year under review a total of 1,377,088 cars and locomotives was inspected, and 38,808 or 2.82 per cent were found defective, as compared with 2.58 per cent defective out of 1,221,039 inspected during fiscal 1942. Included in the rolling stock inspected during fiscal 1943 were 33,969 passenger-train cars, of which 860 or 2.53 per cent were found with defective safety appliances, 1,140 defects being reported.

Air-brake tests were made on 3,559 trains, consisting of 161,166 cars, prepared for departure from terminals; and air brakes were found operative on 160,993, or 99.58 per cent of these cars. This percentage, however, was attained only after 1,574 cars having defective brakes had been set out, and repairs had been made to the brakes on 2,053 cars remaining in the trains. "These trains," the report emphasizes, "had been prepared for departure; yet, when afterward tested by our inspectors, it was necessary to set out or to repair the brakes on an average of one car per train."

Similar tests on 1,801 trains arriving at terminals with 89,905 cars showed that the air brakes were operative on 98.02 per cent of the cars. Cars with inoperative brakes averaged approximately one per train.

The report recalls the mention made in its three predecessors of the "use by certain carriers of devices designed to make lock blocks of tightlock couplers inoperative, to compensate for defects in the coupler which were productive of undesired separation of trains"; and of "improper running boards on steam locomotives and incorrect end and side handholds on steam and Diesel-electric locomotives." It goes on to say that "modified designs of tightlock couplers to avoid accidental separations are undergoing tests," while "progress in correction of improper safety appliances on locomotives has been made."

Commenting on the program for equipping cars with AB brakes, the report notes that "during 8½ years, or 85 per cent of the 10-year period allotted for making this improvement, only 39 per cent of the freight cars in interchange service have been equipped with the present standard airbrake apparatus." Breakdown of the figures shows that 42.2 per cent of the railroad-owned cars were equipped as of June 30, but only 21.2 per cent of the cars owned by private car lines. "Under the stress of wartime traffic conditions," the report says, "it is particularly important that the advantages of this improved equipment should be made fully available as rapidly as possible."

At the close of the fiscal year, 65,080

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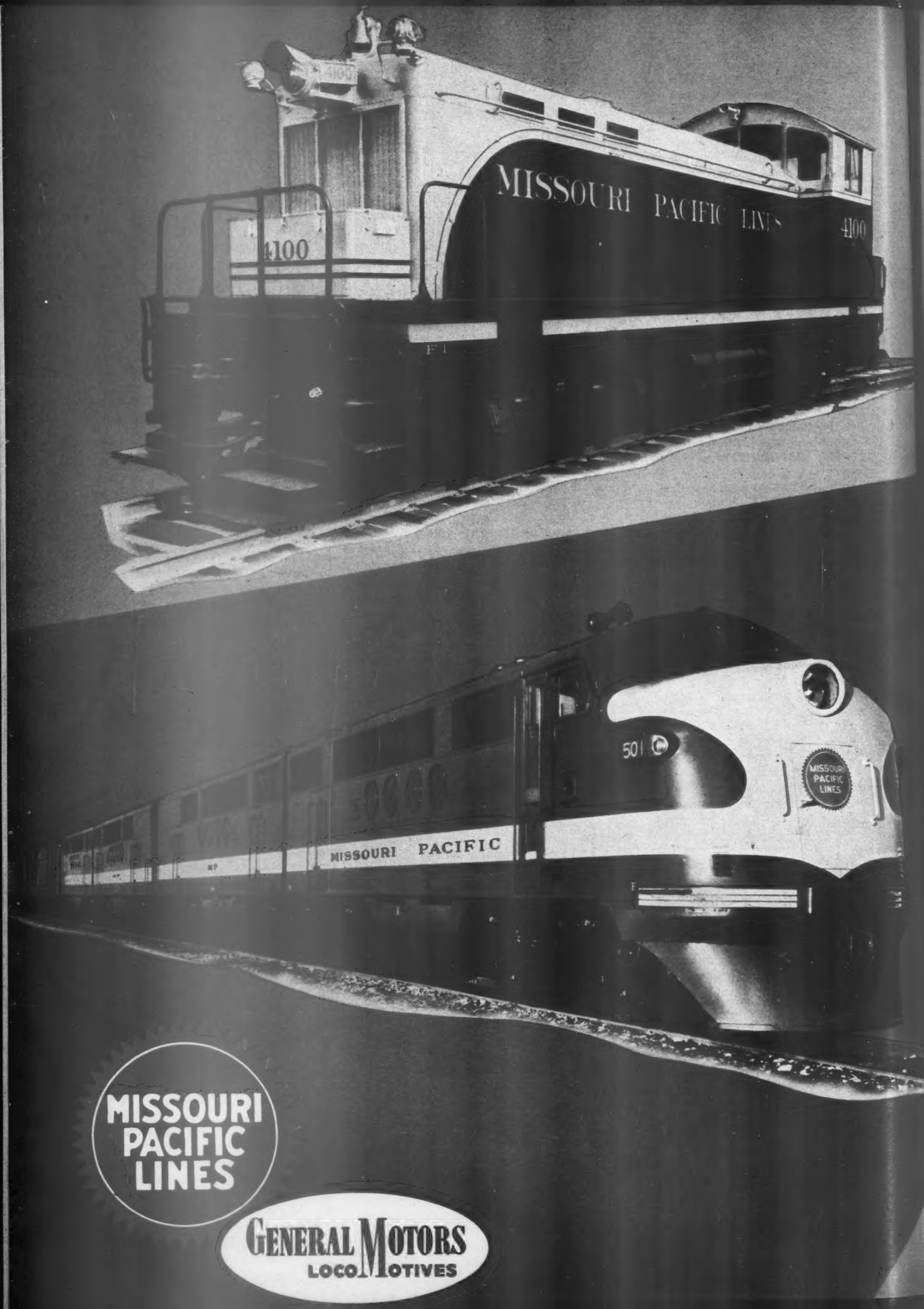

LET'S ALL BACK THE ATTACK — BUY MORE WAR BONDS

covered freight cars had been equipped with metallic running boards of various types, for purposes of investigation and tests, as permitted by orders of the commission. The bureau has inspected such running boards on 5,294 cars. Effective January 1, 1944, running boards made of material other than wood may not be applied to cars unless approved by the Interstate Commerce Commission.

Alleged violations of the safety appliance laws in 185 cases comprising 411 counts were transmitted to United States attorneys during the year; also, 60 cases comprising 446 counts alleging violations of the hours-of-service law. One case of violation of the accident-reports act, comprising 10 counts, covering failure of a carrier to make reports of accidents to employees, was filed during the year and was disposed of by payment of a fine of $1,000. On June 30, 1943, there were pending in various courts 123 safety appliance cases containing 309 counts and 33 hours-of-service cases containing 344 counts.

Pullman Company Postwar Plans

A POSTWAR national transportation policy of equal opportunity for all carriers was advocated by George A. Kelly, vice-president of the Pullman Company, in an address before the Chicago chapter of the Railway & Locomotive Historical Society at Chicago on January 14. In the postwar period, he said, the Pullman Company will enter the spirited competition that is sure to develop, with sleeping-car innovations that are calculated to hold a large portion of its heavy wartime passenger business.

"Pullman's postwar sleeping car innovations are planned to broaden its travel market by offering low-cost berths at rates considerably lower than those now in force and private rooms with the latest comforts and conveniences for little if any more than the present cost of a lower berth," Mr. Kelly stated.

Reviewing the tremendous wartime accomplishments of the railroads and Pullman, Mr. Kelly stated that this job is being done with 15,000 fewer railroad day coaches than were in operation during the last war. After Pearl Harbor, the Pullman Company assigned 1,500 of its fleet of 7,000 mobile cars to the handling of military personnel, the speaker recalled. "Today nearly half of all Pullman sleeping cars are continuously engaged in the transportation of troops, a car being loaded with troops, on the average, every two minutes and 40 seconds, with an average of 30,000 troops moving and sleeping every night in these cars," he added.

Since the United States entered the war 17,000,000 troops have been transported in Pullman cars in organized movements, according to Mr. Kelly. "This," he said, "is just double the total of 8,714,582 troops carried in railroad coaches and Pullman cars combined during the entire period of World War I. In the last war only about one fourth of the troops traveled in Pullman cars, but today 66 per cent of all troops are transported in sleeping cars."

Supply Trade Notes

GRIFFIN WHEEL COMPANY.—*Herbert J. Rosen,* operating manager of the Griffin Wheel Company, Chicago, has been elected vice-president. *Harry Hanson,* secretary and assistant treasurer, has been elected treasurer to succeed *Metzger D. Stimson,* retired. Mr. Rosen entered the employ of the company at Denver, Colo., on July 1, 1900, and after holding various office positions, served as cashier at Chicago, Detroit, Mich., and Denver, Colo., during the period from 1906 to 1914. In the latter year he became assistant to the chief engineer and in 1918 assistant superintendent of the Order division. Later that year he became sales agent at Denver; in 1930 assistant to the vice-president, and in 1934 operating manager.

Herbert J. Rosen

◆

ELECTRIC STORAGE BATTERY COMPANY.—*Roland Whitehurst,* assistant sales manager of the Electric Storage Battery Company since 1940, has been assigned the title of sales manager. Mr. Whitehurst has been in the employ of the company since 1908 and was manager of the Washington branch for 20 years.

◆

J. G. BRILL COMPANY.—*Charles O. Guernsey,* who has been serving in an administrative capacity with the Philadelphia, Pa., ordnance district for the past 20 months, has resumed his position as vice-president of the J. G. Brill Company.

◆

BALDWIN LOCOMOTIVE WORKS.—*D. I. Packard* has been appointed as Chicago district manager of the Baldwin Locomotive Works. Mr. Packard succeeds *Charles Riddell,* who had been Chicago district manager since 1905, and who has a record of 61 years of continuous service with Baldwin. Mr. Riddell will continue his association with the Chicago office as special representative.

Charles Riddell

D. I. Packard was born in Granville Township, Bradford County, Pa., November 26, 1894. He entered the locomotive shops of the New York Central at Avis, Pa., in May, 1911, and, except for one year in the United States Navy during World War I, served in various capacities in the mechanical department of that railroad until December 31, 1923. Mr. Packard became associated with the Franklin Railway Supply Company in January, 1924, and served as resident supervisor of manufacturing operations and as plant manager at Baltimore, Md., until September 1, 1936, when he was transferred to the sales department. While serving as assistant Western sales manager, the War Production Board requested Mr. Packard's services to assist in arranging for the production of components required for the locomotive construction program. This assignment in Washington began in November, 1942, and was terminated on December 15, 1943.

D. I. Packard

◆

GUSTIN-BACON MANUFACTURING COMPANY.—*Ralph C. Harden,* vice-president, has been placed in charge of all sales activities of the company, with headquar-

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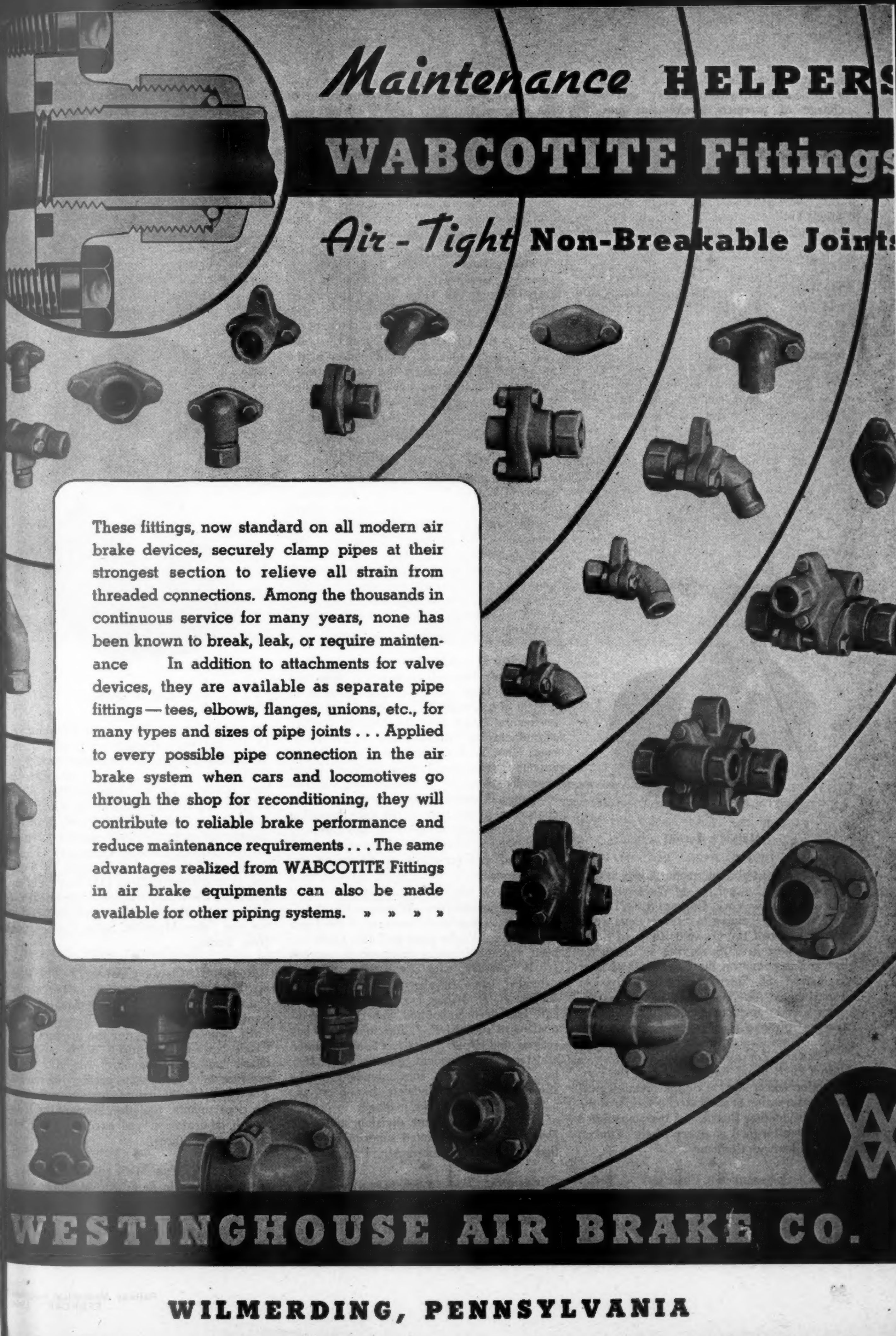
Maintenance HELPERS
WABCOTITE Fittings
Air-Tight Non-Breakable Joints
These fittings, now standard on all modern air brake devices, securely clamp pipes at their strongest section to relieve all strain from threaded connections. Among the thousands in continuous service for many years, none has been known to break, leak, or require maintenance In addition to attachments for valve devices, they are available as separate pipe fittings — tees, elbows, flanges, unions, etc., for many types and sizes of pipe joints . . . Applied to every possible pipe connection in the air brake system when cars and locomotives go through the shop for reconditioning, they will contribute to reliable brake performance and reduce maintenance requirements . . . The same advantages realized from WABCOTITE Fittings in air brake equipments can also be made available for other piping systems. » » » »
WESTINGHOUSE AIR BRAKE CO.
WILMERDING, PENNSYLVANIA

ters at Kansas City, Mo., and New York. *J. F. Stephens*, vice-president, will be in charge of product development and research, and *J. O. Brelsford*, general manager of production, will be in charge of manufacturing.

◆

PITTSBURGH STEEL COMPANY.—*Carl L. Zak*, since 1941 secretary of the Seamless Steel Tube Institute, Pittsburgh, Pa., has been appointed manager of tubular sales for the Pittsburgh Steel Company.

◆

UNITED STATES STEEL CORPORATION.—*M. D. Howell*, vice-president, secretary and treasurer of the United States Steel Corporation, has been appointed also to the newly created position of assistant to the president.

◆

OXWELD RAILROAD SERVICE COMPANY.—*Melvin J. Rotroff* has been appointed district manager, Chicago and Mississippi Valley area, for the Oxweld Railroad Service Company, a unit of Union Carbide & Carbon Corporation. Mr. Rotroff began his career as a machinist at the Lima, Ohio, shops of the Lake Erie & Western (now part of the New York, Chicago & St. Louis) and later took training in oxyacetylene welding. He joined the Oxweld Railroad Service Company in 1928, serving as instructor at various points on the Reading, and later as district superintendent, Eastern division. For the past four years he has been assistant general superintendent, with headquarters in Chicago.

Melvin J. Rotroff

◆

TIMKEN ROLLER BEARING COMPANY.—*Ralph L. Wilson*, former chief of the construction steels section of the metallurgical and conservation branch, steel division, of the War Production Board, has been appointed chief metallurgical engineer of the Timken Roller Bearing Company.

◆

AJAX-CONSOLIDATED COMPANY.—*Consolidated Equipment, Inc.* and the *Ajax Hand Brake Company* have been merged, effective January 1, into the Ajax-Consolidated Company. Officers of Consolidated have been elected officers of the new company.

AMERICAN STEEL & WIRE COMPANY.—*L. F. McGlincy*, general superintendent of the Donora, Pa., steel & wire works of the American Steel & Wire Company, subsidiary of the United States Steel Corporation, has been appointed assistant manager of operation, Pittsburgh, Pa., district. *Loren J. Westhaver*, assistant general superintendent at Donora, has been appointed general superintendent to succeed Mr. McGlincy.

◆

OLIVER IRON & STEEL CORPORATION.—*James G. Graham* has been appointed general manager of sales and *Edward M. Welty*, assistant general manager of sales, of the newly-formed industrial fasteners division of the Oliver Iron & Steel Corporation. The division will handle sales in the industrial, transportation and jobbing fields. *Bennett W. Johnson* has been appointed general manager of sales of the pole line hardware division and *Bernard J. Beck*, general production manager.

◆

VULCAN IRON WORKS.—*E. J. McSweeney* has been appointed president of the Vulcan Iron Works, Wilkes-Barre, Pa., to succeed *E. Perry Holder*, who resigned several months ago to become president of the Wickwire-Spencer Steel Company. Mr. McSweeney was formerly vice-president in charge of motive power of the Baltimore & Ohio. *F. A. Stead* has been appointed vice-president in charge of sales for the company and *F. M. Kern*, vice-president in charge of operations.

◆

DAYTON RUBBER MANUFACTURING CO.—*T. C. Davis*, formerly manager of industrial sales, has been appointed vice-president in charge of mechanical sales planning and experimental sales for the Dayton Rubber Manufacturing Company and *T. D. Slingman*, New York district manager, has been appointed vice-president in charge of mechanical sales. *H. S. Mooradian*, superintendent, has been appointed vice-president in charge of production in the manufacturing and development division of the company and *Joseph Rockoff*, chief chemist, has been appointed vice-president in charge of development.

◆

LIMA LOCOMOTIVE WORKS.—*Frank C. Cutter*, assistant work manager of the Lima Locomotive Works plant at Lima, Ohio, has been appointed works manager to succeed *H. W. Snyder*, who has been granted an extended leave of absence because of ill health. *E. E. Miller*, assistant superintendent, has been appointed general superintendent to succeed *F. J. Bascombe* who has retired, and *W. A. Smith* has been appointed assistant superintendent to succeed Mr. Miller. *F. J. Parsons*, superintendent of the shovel and crane division, has been appointed assistant works manager in charge of the shovel and crane division, and *Fred Rentz* has been appointed superintendent of that division to succeed Mr. Parsons.

◆

NATIONAL BATTERY COMPANY.—*W. C. Shull*, assistant manager of account sales and divisional sales manager of the Depew, N. Y., office of the National Battery Company, has been appointed manager of National account sales.

PITTSBURGH SCREW & BOLT CORPORATION.—*Robert W. Dierker*, manager of sales of the Gary Screw & Bolt Division of the Pittsburgh Screw & Bolt Corporation, Chicago, has been promoted to general manager of sales. *Gerald J. Garvey*, assistant manager of sales, has been made manager of railroad sales and *Bernard C. Ruthy*, has been appointed assistant manager of sales.

◆

LUKENS STEEL COMPANY.—*Paul D. Mallay* has joined the Lukens Steel Company and its subsidiaries, By-Products Steel Corporation and Lukenweld, Inc., as manager of the company's railroad division. *Pinkney W. Love*, for the past several years special representative for Lukens in Washington, D. C., has been appointed manager of the Washington office to succeed *Charles A. Carlson*, who is resigning to establish his own business for the manufacture of the Carlson Internal Combustion Engine.

Paul D. Mallay

Paul D. Mallay was formerly railroad representative in the southeastern territory for the Garlock Packing Company. He is a graduate of the Stevens Institute of Technology and from 1925 to 1934 was chief engineer of the transportation department and manager of the Transite pipe department for the Johns-Manville Sales Corporation, New York.

◆

ROBERT H. CLARK COMPANY.—The Robert H. Clark Company of Los Angeles, Calif., has completed a new plant at 9330 Santa Monica Boulevard, Beverly Hills, Calif., where facilities for the production of Clark adjustable cutting tools and the Clark automatic tapping machine conversion unit have been greatly increased. The plant houses manufacturing and service departments, tool development and research laboratories, and executive and administrative offices.

◆

YALE & TOWNE MANUFACTURING COMPANY.—The Yale & Towne Manufacturing Company, Philadelphia, Pa., division, has placed its railroad representation in the St. Louis, Mo., area with *Clarence Gush*. Mr. Gush has been identified with the selling

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of railway products for many years in St. Louis and has established headquarters there for several prominent manufacturers of materials-handling equipment.

Obituary

WILLIAM H. FOSTER, for ten years railroad lubrication service engineer of the Socony-Vacuum Oil Company, died January 9. Mr. Foster was 70 years of age.

H. CLAY SMITH, president of the Superior Hand Brake Company, died in Chicago on January 4. Mr. Smith was born in Clay County, Missouri, in 1872 and spent the early part of his career as an operator and auditor on several small railroads in Texas. He organized the Smith and Allen Manufacturing Company, the name of which was later changed to the Allith Prouty Company. Subsequently he was elected president of the Danville Malleable Iron Company, from which position he resigned to organize the Superior Hand Brake Company.

RAYMOND D. JENKS, vice-president of the Dominion Brake Shoe Company, Canadian subsidiary of the American Brake Shoe Company, who died on December 28, as announced in the January issue, was 56 years

Raymond D. Jenks

of age. He had been associated with the sales department of the American Brake Shoe Company for 20 years. He was appointed vice-president of the Canadian subsidiary in November, 1934, elected a director in September, 1935, and a member of the executive committee on December 1, 1943. Mr. Jenks was also in charge of advertising for the Brake Shoe & Castings division.

L. P. BOWEN, representative of the railway department of the Dearborn Chemical Company, Chicago, died December 17.

WILLIAM G. IRWIN, chairman of the board of the Cummins Engine Company, died December 14.

JOHN A. MCCORMICK, chairman of the Independent Pneumatic Tool Company and the Great Lakes Dredge & Dock Co., died on December 30.

JOHN MAXWELL GILLESPIE, vice-chairman of the board of directors of the Lockhart Iron & Steel Co., died December 6. Mr. Gillespie had been associated with the Lockhart company for 47 years.

Personal Mention

General

ADAM MCGREGOR, locomotive inspector of the Canadian National at Winnipeg, Man., has been appointed mechanical inspector at Montreal, Que.

HOWARD ROELOFS has been appointed assistant superintendent of motive power and equipment of the Alaska Railroad, with headquarters at Anchorage, Alaska.

F. W. TAYLOR, master mechanic of the Northern Pacific at Glendive, Mont., has been appointed assistant superintendent of motive power, with headquarters at St. Paul, Minn.

GEORGE LESLIE DICKSON, who has retired as electrical and signal engineer of the Atlantic Region of the Canadian National, at Moncton, N. B., as announced in the January issue, was born at Truro, N. S., on December 24, 1878, and was a graduate of Acadia University at Wolfville, N. S., with a B.A. degree in 1900. He received his master's degree the following year and then went to McGill University at Montreal, Que., for the post-graduate study of electricity. Mr. Dickson entered railway service on October 17, 1917, as electrical foreman of the Canadian Government (now Canadian National) with headquarters at Moncton. In July, 1918, he was appointed general power plant inspector, and from June to December, 1920, he was granted leave of absence to serve on the Grand Trunk Arbitration Commission. He became electrical and signal engineer, Atlantic region, in March, 1923. A member of the Engineering Institute of Canada, he is councillor and vice-president-elect of the Moncton branch. He is also a past president of the Association of Professional Engineers of the Province of New Brunswick.

FREDERICK W. HANKINS, assistant vice-president in charge of real estate, purchases, and insurance of the Pennsylvania, has retired from that position after nearly 53 years of railroading. Mr. Hankins was born at London, England, and entered railroad service in 1891 as a machinist apprentice in the employ of the Pittsburgh & Western (now Baltimore & Ohio), at Fox-

Frederick W. Hankins

burg, Pa. He joined the Pennsylvania as a machinist in 1897, subsequently filling a large number of positions in the motive-power department. After various successive promotions, Mr. Hankins, in 1923, became general superintendent of motive power of the central region, with headquarters at Pittsburgh, Pa. He was named chief of motive power, with headquarters at Philadelphia, in 1927. In 1936 he was appointed assistant vice-president-chief of motive power; in 1941, assistant vice-president in charge of operation, and in January, 1942, assistant vice-president in charge of real estate, purchases, and insurance.

A. H. FIEDLER, assistant superintendent of motive power of the Northern Pacific at St. Paul, Minn., has been transferred to the position of assistant superintendent of motive power at Seattle, Wash.

FRED A. BALDINGER, acting superintendent of motive power of the Baltimore & Ohio for the past year, with headquarters at Baltimore, Md., has been appointed superintendent of motive power.

JOHN L. TRIPLETT, chief draftsman of the Texas & Pacific at Marshall, Texas, has been appointed engineering assistant to the superintendent of motive power at the Western Maryland, with headquarters at Hagerstown, Md.

JOHN H. MCALPINE, who has retired as superintendent of motive power and car equipment of the Canadian National at Moncton, N. B., as announced in January, was born at Komoka, Ont., on November 26, 1876, and entered railroad service in February, 1903, at Winnipeg, Man., as foreman boilermaker of the Canadian Northern (now Canadian National). In October, 1903, he became boiler inspector at Winnipeg, and in June, 1907, locomotive foreman at Saskatoon, Sask. Other positions in which Mr. McAlpine served on the Canadian Northern included that of locomotive foreman at Fort Rouge, Man., and master mechanic at Parry Sound, Ont., and Toronto. In March, 1923, he became superintendent in the mechanical department of the Canadian National at Toronto, being appointed superintendent of motive power and car equipment at North Bay, Ont., in September, 1925. In April, 1930, he was appointed superintendent of motive power at Montreal, and in July, 1932, the duties of supervising car equipment maintenance work in the Montreal district were added to his responsibilities.

George L. Ernstrom, assistant superintendent of motive power, Lines West, of the Northern Pacific at Seattle, Wash., has been appointed superintendent of motive power, with headquarters at St. Paul, Minn. Mr. Ernstrom was born in Norway on May 28, 1886, and entered the service of the Northern Pacific on May 1, 1903, as a locomotive fireman at Duluth, Minn. He later served as engineman and as road foreman

George L. Ernstrom

of engines at Forsyth, Mont., and Glendive, and on May 1, 1926, was assigned to special duty, conducting tests for the fuel department, with headquarters at Livingston, Mont. On May 1, 1928, Mr. Ernstrom became master mechanic, with headquarters at Staples, Minn., later being transferred to Pasco, Wash., and Missoula. In 1930 he was appointed general master mechanic, with headquarters at St. Paul, and on March 1, 1941, was transferred to Seattle. On June 16, 1942, Mr. Ernstrom became assistant superintendent of motive power, Lines West.

George A. Steuber, assistant general manager of the Despatch Shops, Inc., plant

George A. Steuber

at East Rochester, N. Y., has been appointed general manager and a director of the company. Mr. Steuber was born at Pittsburgh, Pa. He entered the employ of the Merchant Despatch Transportation Company (now Despatch Shops, Inc.), as a material checker in the steel fabricating department. The following year he was transferred to the engineering department, where he completed a four-year apprenticeship in car design. In connection with this work, he attended Mechanics Institute for five years, studying structural steel design and higher mathematics. In 1917 he was enrolled at Tri-State College of Engineering at Angola, Ind., but at the declaration of war in April, Mr. Steuber enlisted in the United States Navy, engineers division. Following an honorable discharge from the Navy in 1919, he returned to the Despatch Shops as chief draftsman, advancing successively to foreman of the steel fabricating department, general foreman, superintendent and assistant general manager.

H. F. Finnemore, who has been appointed assistant chief electrical engineer of the Canadian National, with headquarters at Montreal, Que., as announced in the January issue, was born at Chicago on March 18, 1893. He received a B.S. degree in electrical engineering from Queen's University at Kingston, Ont., in 1917, entering railroad service in March of the following year as a draftsman for the Canadian Government Railways (now Canadian National). In September, 1922, he was appointed assistant engineer of the Canadian National, and in 1923, assistant electrical engineer with headquarters at

H. F. Finnemore

Montreal, Que. In July, 1938, he became electrical engineer at Montreal, in which position he remained until his recent appointment as assistant chief electrical engineer. Mr. Finnemore has been in charge of many important electrical assignments, including the development of Diesel-electric cars; the introduction of air-conditioning in Canadian National passenger equipment, and the installation of the electrification system for the Montreal terminal development.

Thomas H. Dickson, supervisor of unit cars of the Canadian National, has been appointed electrical engineer, with headquarters at Moncton, N. B. Mr. Dickson was born at Pictou, N. S., and graduated from Dalhousie University at Halifax, N. S., in 1920 with a B.A. degree. In 1922 he received a B.S. degree in electrical engineering from the Nova Scotia Technical College. He entered the service of the Canadian National on May 1, 1925, as a

Thomas H. Dickson

draftsman in the mechanical department, and in September, 1926, was appointed supervisor of unit cars.

Master Mechanics and Road Foremen

C. A. Martin has been appointed road foreman of the Canadian Pacific, with headquarters at Riviere du Loup, Que.

A. S. Geddes has been appointed road foreman of the Moncton, N. B., division of the Canadian Pacific.

W. F. Forster has been appointed road foreman on the Canadian Pacific, with headquarters at Campbellton, N. B.

G. R. Greenough has been appointed road foreman of the New Glasgow division of the Canadian Pacific, with headquarters at New Glasgow, N. S.

M. T. Llewellyn, master mechanic of the Chesapeake & Ohio at Ashland, Ky., has been appointed master mechanic of the Hinton division.

Page Carlisle, master mechanic of the Moncton division of the Canadian National, with headquarters at Moncton, N. B., has retired.

E. H. Stirling has been appointed road foreman of the Edmundston division of the Canadian Pacific, with headquarters at Edmundston, N. B.

Paul H. Giesking, supervisor of Diesel equipment of the Denver & Rio Grande Western, with headquarters at Denver, Colo., has been promoted to master mechanic at Grand Junction, Colo.

Norman V. Hendy, road foreman of engines of the Northern Pacific at Missoula, Mont., has been promoted to the position of master mechanic, with headquarters at Glendive, Mont.

Dan G. Cunningham, master mechanic of the Denver & Rio Grande Western at Salt Lake City, Utah, retired on December 31.

J. F. Fisher has been appointed road foreman of the Halifax division of the Canadian Pacific, with headquarters at Truro, N. S.

G. R. Greenough, road foreman of engines of the New Glasgow division of the Canadian National, has been appointed master mechanic of the New Glasgow division, with headquarters at New Glasgow, N. S.

Walter Medlock, master mechanic of the Denver & Rio Grande Western at Grand Junction, Colo., has been transferred to the position of master mechanic at Salt Lake City, Utah.

J. R. Conn, master mechanic of the New Glasgow, N. S., division of the Canadian National, has been transferred to the position of master mechanic of the Moncton division, with headquarters at Moncton, N. B.

Frank Robert Butler, who has been appointed master mechanic of the Chesapeake & Ohio at Ashland, Ky., as announced in the January issue, was born on August 12, 1883, at Chicago. He was raised in Allegheny County, Virginia; attended high school at Covington, Va., and studied engineering at the Virginia Polytechnic Institute from 1900 to 1904. He entered the employ of the Chesapeake & Ohio as a special apprentice at Huntington, W. Va., on November 1, 1905. He was promoted to the position of night enginehouse foreman at Handley, W. Va., on June 15, 1909. and became day enginehouse foreman at Handley on August 1, 1910; general foreman at Russell, Ky., on October 1, 1911; general foreman at Lexington, Ky., on August 1, 1914, and master mechanic at Ashland on December 1, 1943.

Car Department

W. J. McClosky, general car foreman of the Illinois Central at Centralia, Ill., has retired after 33 years of service.

William W. Calder, supervisor of car maintenance of the Baltimore & Ohio, has retired after 43 years of service on that road.

Alfred F. Pugh, general car foreman of the Baltimore & Ohio, at Cleveland, Ohio, has been appointed assistant regional master car builder, with headquarters at Cleveland.

A. A. Campbell, assistant general superintendent of car equipment, Western region, of the Canadian National at Winnipeg, Man., has retired because of ill health.

Ralph B. Fisher, assistant regional master car builder of the Baltimore & Ohio at Pittsburgh, Pa., has been appointed regional master car builder, with headquarters at Pittsburgh.

Hugh H. Young, assistant general car foreman of the Illinois Central, with headquarters at Centralia, Ill., has been appointed general car foreman, with headquarters at Centralia.

Arthur H. Keys, formerly regional master car builder of the Baltimore & Ohio at Pittsburgh, Pa., has been appointed assistant superintendent, car department, with headquarters at Baltimore, Md.

E. H. Jenkins, car foreman of the Canadian National, with headquarters at Edmonton, Alta., has been promoted to assistant general superintendent of car equipment, Western region, with headquarters at Winnipeg, Man.

Shop and Enginehouse

Luke Wedge, superintendent of the motive power shops of the Canadian National at Ft. Rouge, Man., has retired.

A. J. Gibbons, foreman of the erecting shops of the Canadian National at Fort Rouge, Man., has been appointed superintendent of the motive power shops, with headquarters at Fort Rouge.

Purchasing and Stores

Clarence F. Post, purchasing agent of the Western Pacific at San Francisco, Calif., has retired after 27 years of service.

P. L. Grammet, assistant purchasing agent of the Pennsylvania, has retired after more than 52 years of continuous service.

Stanley K. Proffitt, assistant purchasing agent of the Western Pacific, with headquarters at San Francisco, Calif., has been appointed purchasing agent, with headquarters at San Francisco.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

Electric Tool Maintenance.—Skilsaw, Inc., Chicago. Wartime maintenance manual, with a special section on "How To Get the Most from Your Portable Electric Tools." Illustrated.

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50 Years of Inland Steel.—Inland Steel Company, 38 South Dearborn street, Chicago 3. Sixty-four page story of the growth of the Inland Steel Company since its beginning in 1893. Illustrated in color.

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Welding Positioning Equipment.—Ransome Machinery Company, Dunellen, N. J. Four-page bulletin, No. 201, concise presentation of specifications, important features, load rating tables, and dimensions of full Ransome line of welding positioning equipment.

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Incandescent Lighting. — Holophane Company, Inc., 342 Madison Avenue, New York. Twenty-two page illustrated booklet, "Lighting Specific for Railroads." Contains recommendations for the lighting of medium size railway stations, freight houses, office and file rooms, freight team yards and driveways, coal and water facilities, enginehouses, machine shops, locomotive repair shops, car shops, paint shops, etc. Suggests arrangement of lighting units, procedure, lighting intensities and types of fixtures best suited for different applications. Fluorescent lighting is not included in this catalogue because of the current material situation. Passenger car lighting will also be covered as a separate subject.

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Table Napery.—Rosemary Sales, a division of the Simmons Company, 40 Worth Street, New York 13. "Table Napery—Its Importance, Its Use and Care" published in the interests of hotels, restaurants, railroads, hospitals, etc., shows various table set-ups using Rosemary Tablecraft, and gives specific recommendations for the removal of various types of stains as well as for the preparation of tablecloths and napkins for laundering.

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Steel Cutting with Carbides.—Carboloy Company, Inc., Detroit 32, Mich. Manual GT-166, a 16-page vest-pocket guide to top performance in steel cutting. Covers characteristics of different grades of carbides designed for steel cutting, selection of proper rake and relief angles, size of radius, etc., and operating hints.

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Insulation Testers.—James G. Biddle Co., Philadelphia, Pa. Bulletin No. 1735 describes Megger instruments now being made in this country for testing insulation resistance. The instruments are of the generator and direct-reading ohmmeter type, which operate simply by turning a crank and reading a scale. They are identical with the Meg and Super-Meg testers formerly made by this company, except that they are housed in plastic molded cases.

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Welding Stainless Steel.—Allegheny Ludlum Steel Corporation, Brackenridge, Pa. Sixty-four page booklet, illustrated in color. Interprets techniques commercially employed, more particularly the precautions to be observed, in the welding of stainless steel by the accepted processes. Full-color perspective drawings and diagrams illustrate various methods used and the physical and chemical phenomena which occur (or must be prevented from occurring) when stainless steel is welded. Six chapters: Effects of Heat on Stainless Steels; Metallic Arc Welding; Atomic Hydrogen Welding; Oxygen-Acetylene Welding; Electrical Resistance Welding, and Welding Pluramelt Steels.

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Crane Maintenance.—Harnischfeger Corporation, Milwaukee, Wis. Pocket-size manual, arranged in question and answer form and indexed for quick reference, for men in charge of servicing overhead electric traveling cranes. Points out the most likely causes of specific troubles. Under each question are listed the probable contributing conditions which should be inspected and remedied to stop trouble at its source. Contains also complete lubrication charts, standard crane operating signals, a sample inspection report, operating cautions, and a schedule on safe lifting of loads with chain, wire-rope, manila-rope, and the sisal-rope slings.